National Aeronautics and
Space Administration

Report on the OSSA Payload Integration Center/ Payload Operations Center Workshop

held at Cocoa Beach, Florida

December 6-9, 1988

March 16, 1989

OFFICE OF SPACE SCIENCE AND APPLICATIONS
NASA Headquarters
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Chapter 1: Introduction

The Office of Space Station Freedom has established an operational scenario which includes concepts for distributed, user-sponsored payload integration and payload operations facilities. These facility concepts, dubbed "Science and Technology Centers" (for payload integration) and "Discipline/Regional Operations Centers" (for payload operations) include many features which are inherently attractive to users. However, implementation of such concepts entail difficult technical and budgetary decisions which user organizations must make for themselves.

The Office of Space Science and Applications (OSSA) has begun the process of establishing its space station utilization goals and defining an overall implementation methodology for achieving these goals. One major element of this implementation methodology addresses the facilities and procedures which must be developed to handle payload integration functions and payload operations functions.

While the subjects of payload integration and operation have been considered in a number of space station utilization planning activities, it was not until the Payload Integration Center/Payload Operations Center Workshop (December 6-9, 1988, at Cocoa Beach, Florida) that these subjects have been treated in a direct and comprehensive manner by OSSA. This workshop, sponsored jointly by the Flight Systems Division and the Communications and Information Systems Division of OSSA, focused the expertise of participants from OSSA, other NASA organizations, other U.S. government agencies, and the International Partners on the requirements for integration and operations centers.

Purpose of the Report

The purpose of this report is to summarize the proceedings of the Payload Integration Center/Payload Operations Center Workshop and to present the data and other findings obtained through the workshop. The report summarizes the background and methodology of the workshop, as well as follow-on steps to be pursued by OSSA.

Definitions of Payload Integration Centers and Payload Operations Centers

"Payload integration centers", referred to as Science and Technology Centers in the Space Station Operations Task Force (SSOTF) activities, were defined in the SSOTF Panel 2 report as facilities which "integrate discipline users requirements and provide [a] surrogate role and support for them during the integration process." The responsibilities of a payload integration center, per the SSOTF, include payload analytical integration, experiment hardware design and fabrication, experiment requirements preparation, hardware physical integration and test, hardware verification and safety, implementation of experiment flight and ground software, and support of in-flight and post-flight experiment analysis.

"Payload operations center", as used in this report, is a generic term that includes many of the concepts associated with a Discipline Operations Center as described by the SSOTF. The SSOTF Report defines Discipline Operations Centers (DOCs) as "user-supplied and operated facilities which provide support to a discipline user group which is centered around a specific area of investigation. They are intended to allow for the sharing of technical support and overhead costs to users with similar discipline needs." The terms payload operations center and Discipline Operations Center were used interchangeably in the workshop. The responsibilities of a Discipline Operations Center, per the SSOTF Panel 1 report, include coordinating the use of communications links, maintaining status and results of discipline operations activities, rescheduling resources within a discipline, resolving intradiscipline conflicts within allocations/constraints, maintaining knowledge of planned and actual resource usage, and maintaining the DOC facility.

While the SSOTF definitions do not necessarily correspond precisely with OSSA plans, they did provide appropriate reference points for the workshop.

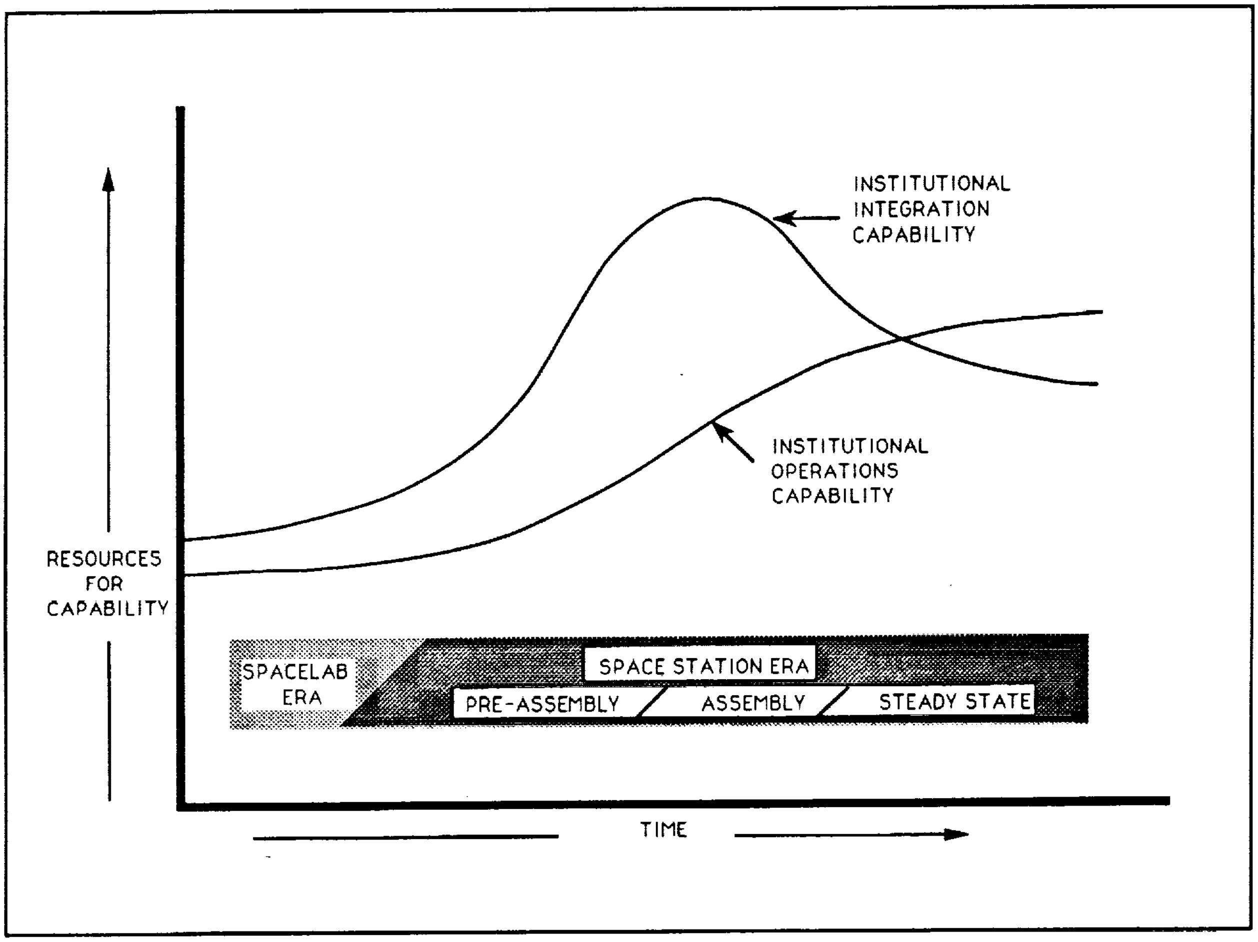

Figure I-1. Conceptual Integration and Operations Requirements

OSSA Perspective on Integration and Operations

As the space station is being developed and completed, the integration and the operations needs of OSSA payloads will vary as a function of time. A conceptual depiction of the way in which integration capabilities and operations capabilities for OSSA payloads might change with time is shown in Figure I-1. Payload integration activity is projected to peak during the assembly phase of the station as its pressurized laboratories and its external attachment sites are outfitted with large numbers of payload systems. Once the station is fully outfitted, payload integration requirements should decrease as the rate of new payloads being readied for station opportunities lessens. Care must be taken not to overdevelop the capabilities for the "peak", thus resulting in "white elephants" after the assembly phase.

Payload operations activity, on the other hand, will increase as the space station is filled, and then level out in the mature station operations phase. Note that the curves shown are illustrative—actual shapes will depend on many factors, but the "phase" concept is realistic.

As the coordinator and integrator of all U.S. science and utilization activities (see the description below of the Space Station Science and Application Utilization Plan), OSSA seeks to develop a position on the design and implementation of payload integration and payload operations capabilities in order to serve the needs of its science community and the needs of its sister agencies. In order to initiate long-lead activities in a timely fashion, OSSA needs to establish a position and associated budget strategy as part of the FY 1991 budget process.

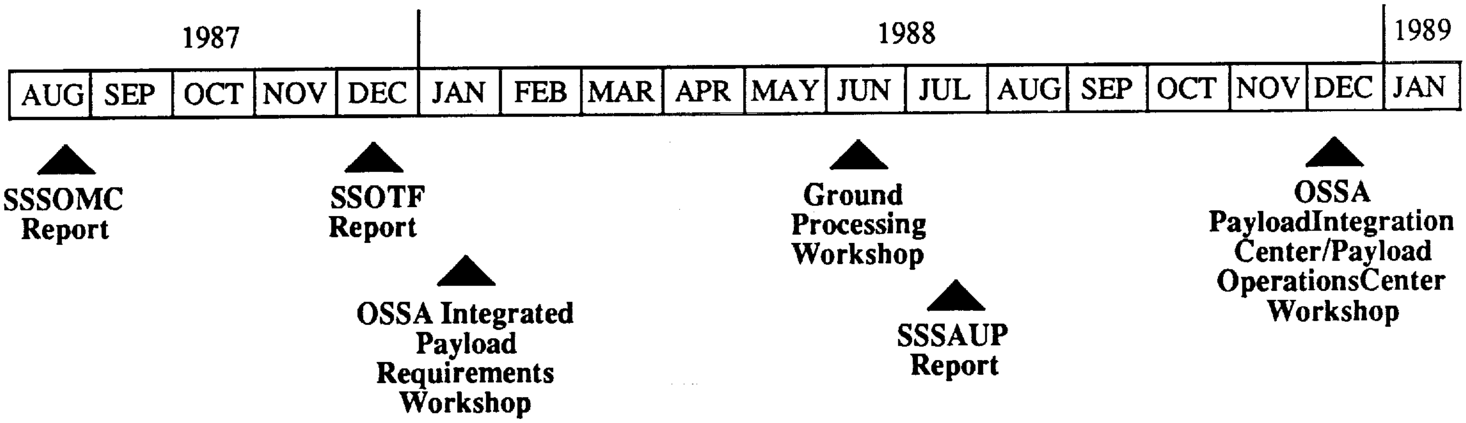

Figure I-2. Activity Timeline

Previous OSSA Activities

Over the past 18 months several major OSSA activities have addressed the overall management framework needed for effective science utilization of the space station. Completed activities include the Space Station Science Operations Management Concepts (SSSOMC) Study, the OSSA Review of the Space Station Operations Task Force (SSOTF) Report, development of the Space Station Science and Applications Utilization Plan (SSSAUP), and the Science Utilization Management (SUM) study. More recent activities include the Joint Science Utilization Study (JSUS). In addition, two major workshops, the Guntersville Workshop on Integrated Payload Requirements and the KSC Ground Processing Workshop, have also contributed to the structure within which payload integration and operations activities will be planned.

The following paragraphs describe these efforts briefly. The activities occurred in the order shown in Figure I-2.

Space Station Science Operations Management Concepts (SSSOMC) Study. This study was sponsored jointly by OSSA and the Office of Space Station Freedom. Conducted from June to August 1987, the study served as a forcing function to energize OSSA planning for the space station. The recommendations of the conference supported the concepts of distributed payload integration and distributed payload operations, but did not take into consideration manpower and budget implications.

OSSA Integrated Payload Requirements (Guntersville) Workshop. The Office of Space Science and Applications sponsored the OSSA Integrated Payload Requirements Workshop at Guntersville, Alabama, in January 1988. Envelopes of payload requirements based on three different "mission models" were formally submitted by Dr. Lennard Fisk, Associate Administrator for Space Science and Applications, to Mr. James Odom, Associate Administrator for Space Station Freedom, in a memo on April 1, 1988.

OSSA Review of SSOTF Report. OSSA reviewed the SSOTF Report during January-June 1988, with participation from OSSA disciplines, field centers, and representatives from the science community. The review concluded that the SSOTF report was "a significant step toward defining the processes and organizational responsibilities needed to implement space station operations." The review team did not take issue with SSOTF concepts of integration and operation centers, but did feel that it was up to user organizations to design their own supporting infrastructure. The reviewers expressed concern over the role and responsibilities of the Payload Operations and Integration Center (POIC), and recommended that "the user, not the POIC, should be responsible for resource allocation and management...within the user's resource envelope." They also recommended that OSSA consider "sponsoring a general payload systems integration support capability at the launch site."

OSSA Ground Processing Workshop. A Ground Processing Workshop was held at Cocoa Beach, Florida, in June, 1988 to determine end-to-end ground processing requirements for the OSSA reference payloads and to promote interaction between science users and ground processing personnel. A focus was maintained on user requirements which had near-term impact on the definition of new capabilities such as the Space Station Processing Facility (SSPF) and the Test and Monitor Control System.

Space Station Science and Applications Utilization Plan (SSSAUP). The SSSAUP was developed by OSSA in collaboration with the United States Department of Energy, the National Institutes of Health, the National Institute of Standards and Technology, the National Oceanic and Atmospheric Administration, the National Science Foundation, the National Telecommunications and Information Administration, the United States Department of Agriculture, and the United States Geological Survey. It established a top level management framework for science utilization of the space station by all federally sponsored users and encouraged the agencies to work together to pre-integrate plans and requirements prior to delivery to the Space Station Freedom Program. A key feature of this plan was its identification of OSSA as the coordinator and integrator for all U.S. science utilization activities. In this role, OSSA's science support infrastructure (e.g., integration and operations capabilities) would be made available to other agencies. In particular, the SSSAUP specified that OSSA would sponsor a payload experiment processing function at Kennedy Space Center (KSC) and a centralized multidiscipline payload operations center at an unspecified location. Other OSSA-sponsored integration and operations capabilities were left to be defined.

Science Utilization Management (SUM) Study. The SUM study was sponsored by OSSA's Flight System Division in coordination with the OSSA discipline offices. The study team consists of NASA field center personnel experienced in integrated project management, in payload development, and mission operations through the manned Spacelab program. The study was performed to address the functions, management structures, and the processes needed at the NASA field center level to carry out the principles embedded in the Space Station Science and Applications Utilization Plan. While the SUM study establishes recommendations for a management framework, the focus of the Payload Integration Center/Payload Operations Center Workshop is part of the process which will implement those recommendations.

Joint Utilization Studies. Joint studies now underway include the Multilateral Utilization Study (MUS) sponsored by the Space Station Freedom Program and the corresponding Joint Science Utilization Study (JSUS) sponsored by OSSA. The payload allocated mission set developed under the MUS activity was presented at the workshop to assist in scoping the requirements.

These activities may be viewed in the context of an overall planning process described in the following section.

The Planning Process

Integration and operations have related issues and functions. For example, integrated crew training for pressurized payloads—properly an operations function—takes place in the midst of the integration process. Therefore, planning and decision-making for both integration and operations must be viewed as a closely coupled, complementary process.

The overall planning process is illustrated in Figure I-3. First, functional requirements are identified for both areas. In the integration area, particular focus is placed on physical integration (that is, experiment integration—installation of integrated payloads on carriers and verification of interfaces). In the operations area, emphasis is placed on addressing the convergence of science operations functions in payload operations centers, and coordination of functions with the space station.

These functional requirements include:

(1) Core requirements common to most payloads and disciplines;
(2) Discipline or payload-unique requirements; and
(3) Interfaces internal and external to OSSA.

Next, existing capabilities/resources are identified. These are then compared with needs in order to identify shortfalls, alternatives, or potential new requirements. After an overall OSSA approach is developed, it is evaluated against established criteria and revised as necessary. With completion of the iteration, a final integrated OSSA program strategy will result. This program strategy will include delineation of funding responsibilities of the discipline organizations vis-a-vis the support organizations such as the OSSA Flight Systems Division and the OSSA Communications and Information Systems Division.

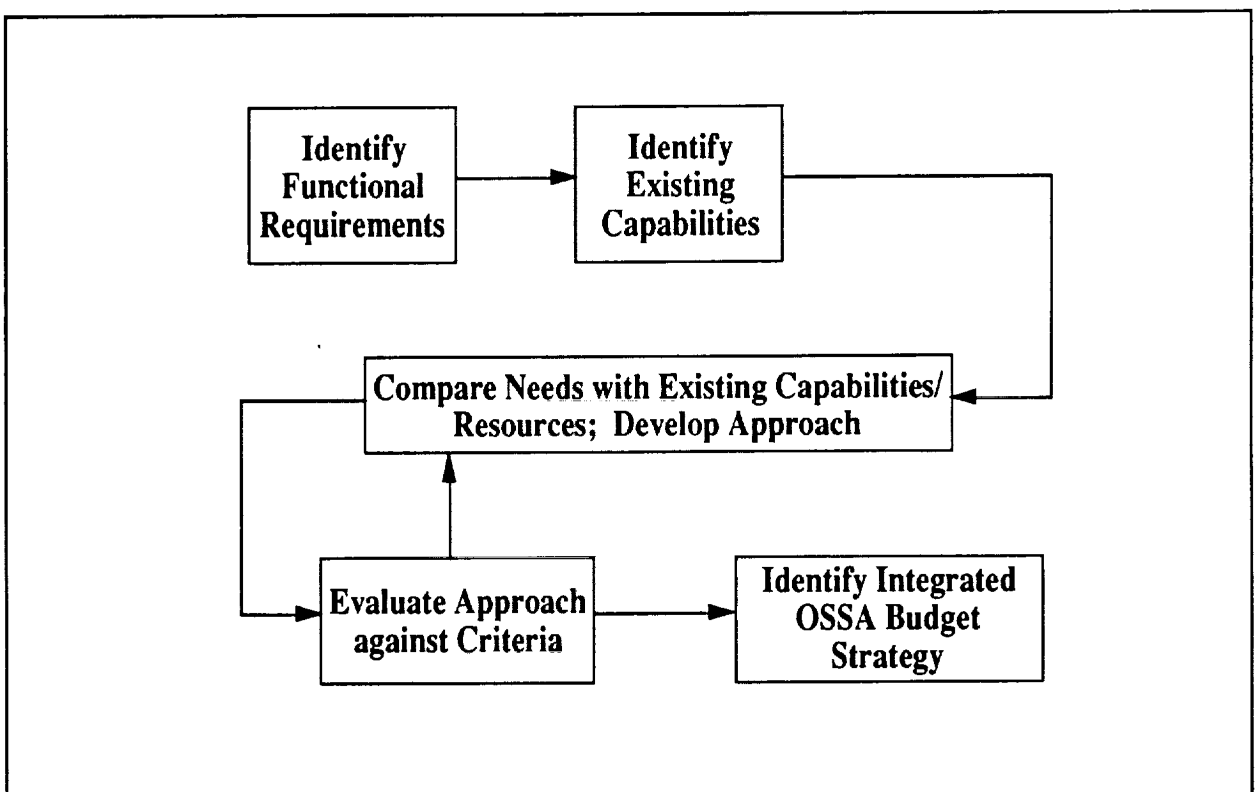

Figure I-3. Workshop Role in the Planning Process

Payload Integration Center/Payload Operations Center Workshop

The centerpiece of the planning process described above is the Payload Integration Center/Payload Operations Center Workshop, sponsored jointly by the Flight Systems Division and the Communications and Information Systems Division and conducted at Cocoa Beach, Florida from December 6 through December 9, 1988. Both divisions, as service organizations for the OSSA discipline offices, had particular interest in the workshop activities. The Flight Systems Division focussed on functional requirements for integration and operations support, while the Communications and Information Systems Division concentrated on supporting information systems requirements.

Purpose of the Workshop. The purpose of the workshop was to assemble information and to identify issues needed to assist OSSA in the development of inputs and resolutions on the most critical budget-driving aspects of payload integration and operations—the facilities for user interface with the space station.

Workshop Role in the Planning Process. The workshop's role in the planning process described above encompasses the first two boxes in Figure I-3 (identification of functional requirements and existing capabilities) and part of the third box (comparison of needs against resources and development of an approach). Note that data analysis and the identification of options does not end with the workshop. Management decisions and budget strategies will be developed as part of the iterative process.

Workshop Points of Departure. To focus discussions during the workshop, the workshop organizers developed strawman architectures for both integration and operations activities. These strawmen, which served as points of departure for the workshop discussion, were generally consistent with the Spacelab "way of doing business", as well as with recommendations from the Science Utilization Management (SUM) team for management of the these activities.

The workshop point of departure for integration (i.e., payload hardware to station flight hardware) assumed that this activity would occur only at the Kennedy Space Center.

The operations point of departure assumed a payload operations center for attached payloads at Johnson Space Center, and a payload operations center for pressurized payloads at Marshall Space Flight Center.

The integration and operations points of departure were characterized in detailed functional matrices which were provided beforehand to the discipline representatives. The latter were requested to review the matrices, revise them based on their understanding of the peculiar needs of their discipline or payloads, and provide specific rationales for those instances where their discipline requirements diverged from the strawman scenarios. These matrices, as submitted by the discipline representatives, are shown in Appendix C.

Workshop Groundrules. In addition to the requirement to address the strawman scenarios just described, the workshop participants were provided with the following groundrules:

1) The OSSA portion of the "allocated test mission set", developed by the Multilateral Utilization Study (MUS), was designated as a mission model for scoping integration and operation requirements. The entire complement allocated to OSSA was assumed to be on orbit by the end of the assembly sequence. For rough phasing of payload flight readiness, key milestones in the current trial payload manifest were used (e.g., first outfitting flight for the U.S. module, launches of the international modules). This information is summarized in Appendix D.

(2) Given the overall OSSA budget constraints and the desire to maximize the use of available funds for acquisition of flight hardware as opposed to ground facilities, optimal use of existing capabilities was one of the groundrules.

(3) Proposed capabilities should be consistent with approved OSSA plans and with space station capabilities at assembly completion. OSSA's plans must also recognize requirements and constraints imposed by flight systems, such as integration certification requirements and STS/Space Station Freedom safety requirements.

Workshop Structure. The workshop consisted of parallel splinter groups for payload integration centers and payload operations centers. During the actual workshop, the Integration Splinter Group further subdivided into a pressurized payload subgroup and an attached payload subgroup. The schedule and the mixture of plenary and splinter group meetings are shown in Figure I-4.

Anticipated Workshop Products. The anticipated workshop products were as follows:

(1) consolidated sets of functional requirements for both operations and integration;
(2) identification of existing capabilities and a comparison with discipline needs;
(3) identification of rationales and issues associated with establishment of payload integration centers and payload operations centers;
(4) initial identification of integrated options.

Post-Workshop Activities. To define overall architectures for payload integration and payload operations capabilities needed to satisfy discipline requirements and to be consistent with overall OSSA funding limitations, OSSA will perform follow-on analysis and review of the workshop results. The results of the workshop, in conjunction with near-term follow-up activities, will be used to establish an OSSA position for further definition and implementation of payload integration and operations capabilities. The derived information will be used to develop an overall program strategy for OSSA space station payload integration and operations support. The requirements developed will be consistent with the evolving Science Utilization Management structure and plan.

The results of the workshop are discussed in the next chapter.

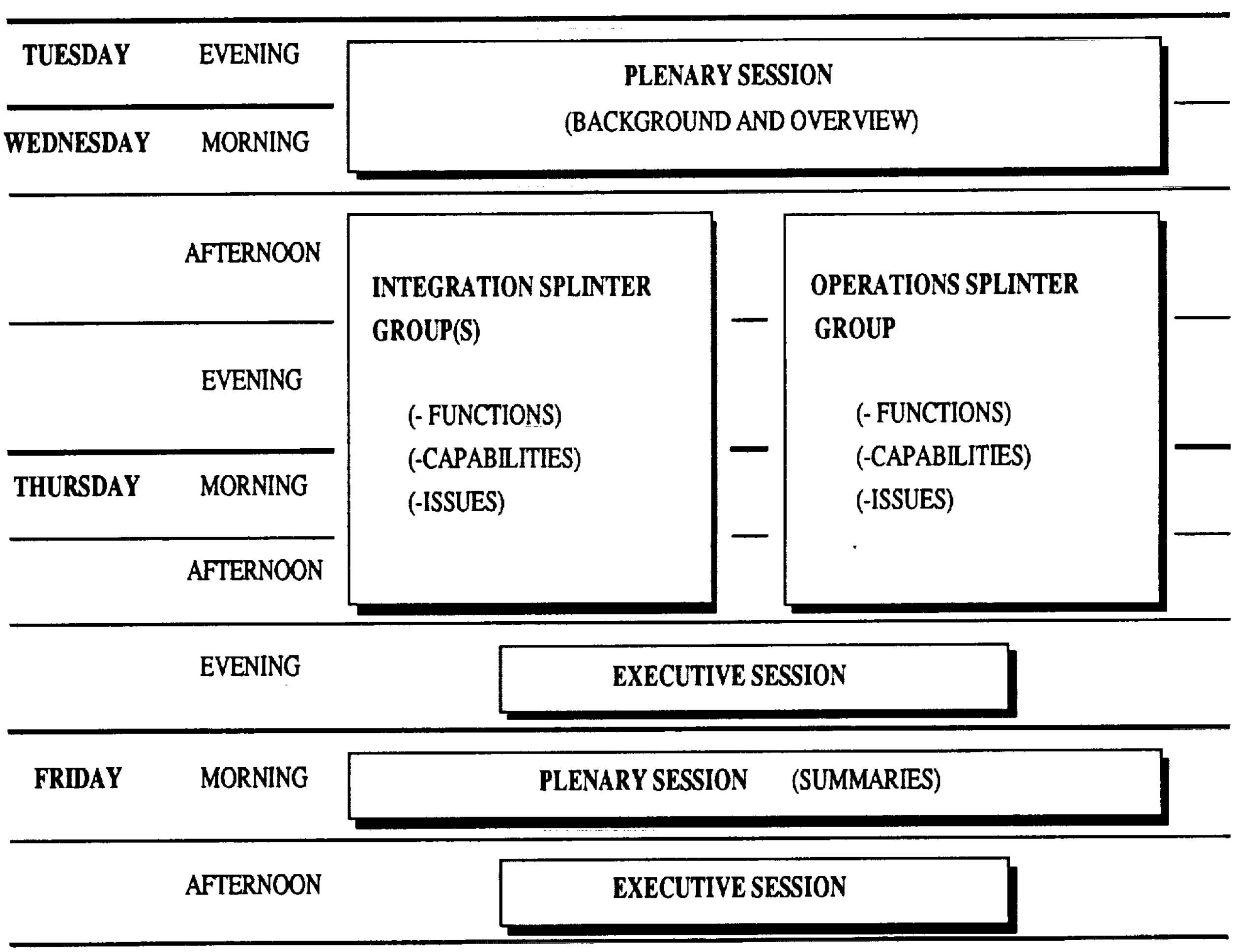

Figure I-4. Workshop Structure

Chapter II: Workshop Results

This chapter is divided into two sections. Results and issues from the integration part of the workshop are presented in the first section, and operations and communications systems results and issues are presented in the second section.

In each of the two sections, the results are followed by a list of issues which arose during the meeting. This organization of the results reflects the way in which the workshop participants approached the overall task and includes the summary information provided by workshop leaders during the plenary session on the last day of the workshop. As a consequence, the report sections differ in character.

Workshop conclusions are presented in Chapter III, and a summary of issues and near-term actions is provided in Chapter IV.

Integration

The Integration Splinter Group remained together for the first meeting day, during which presentations on Center capabilities were given and certification requirements were discussed. On the second day, an Attached Payload Integration Subgroup and a Pressurized Payload Integration Subgroup were formed, and each of these subgroups approached its discussions in a slightly different way. For this discussion of the workshop activities, the results are presented separately for each subgroup. This distinction is not maintained in the next chapter on recommendations and conclusions.

Certification of Integration Centers

Integration centers will have to receive and maintain certification from the Space Station Freedom Program. As reflected by the discussion during this portion of the workshop, the divisions and centers accept the necessity of certification and understand that standard requirements for configuration control, logistics, safety, reliability, quality assurance, etc., will be imposed. The procedural and technical impacts of certification are not yet known, since the requirements are still in development. Identification of these impacts on proposed integration centers—whether NASA or systems contractor facilities—will be a significant factor in determining OSSA's approach(es) to physical integration.

Attached Payload Integration Subgroup

In this subgroup, each division spokesperson (for Earth Sciences and Applications, Solar System Exploration, Space Physics, and Astrophysics) briefly described candidate payloads, and identified for each payload the following information:

(1) Name of payload;
(2) A prime preferred physical integration location;
(3) A backup preferred physical integration location;
(4) Comments or concerns on payload needs; and
(5) An assessment of the impact on the payload project if integration were to be done at KSC.

As noted in Chapter I, only physical integration was considered. For attached payloads, then, integration as used here refers to mounting a payload on a Payload Interface Adapter, a Multiple Payload Adapter, or a Payload Pointing System, with certification of the appropriate facilities and procedures by the space station.

Summary of Center Capabilities for Attached Payloads. Each information item was discussed in the open forum of the subgroup, with Center representatives identifying integration capabilities and limitations as the division spokespersons addressed each payload. Four major Centers (GSFC, JSC, KSC, and MSFC), all of which have major integration capabilities, were discussed (along with contractor locations) as potential integration sites for attached payloads. Table II-1 summarizes the relative Center capabilities (existing or planned) for the four NASA Centers discussed. This information was consolidated from the subgroup discussions and refers only to attached payload integration. The shaded areas in Table II-1 indicate the absence of a capability. Although GSFC and KSC appear to have particular advantages for attached payloads, note that the table applies to attached payloads as a group and does not take into account payload-specific reasons for choosing a particular integration location.

Table II-1. Attached Payload Integration at Centers

ATTACHED PAYLOAD INTEGRATION CAPABILITY / CENTER	GSFC	JSC	KSC	MSFC
MAJOR INTEGRATION CENTER CAPABILITIES	YES	YES	YES	YES
APAE/PPS PERSONNEL KNOWLEDGE BASE	AVAILABLE			
ENVIRONMENTAL FACILITIES AVAILABLE FOR ATTACHED PAYLOADS	AVAILABLE	AVAILABLE	• NO ENVIRONMENTAL BUILDING • NO THERMAL VAC OR ACOUSTIC SITE	• EMI TEST CAPABILITY
WORK PACKAGE ASSISTANCE	• WP-3 FACILITY AVAILABLE • WP-3 TRAINED PERSONNEL AVAILABLE • OPTION IN PLACE IN EXISTING WP-3 CONTRACT FOR ADDITIONAL MANPOWER	• WP-2 NOT ON CONTRACT TO PROVIDE APAE/PPS • NO OPTION AVAILABLE FOR APAE INTEGRATION MANPOWER		• WP-1 NOT ON CONTRACT TO PROVIDE APAE/PPS • NO WP-1 OPTION FOR APAE MANPOWER
ADDITIONAL ATTACHED PAYLOAD FACTORS	• PPS SIMULATOR APAE SIMULATOR		• PLAN TO HAVE PPS SIMULATOR, APAE SIMULATOR • FUNDING FOR TRUSS SIMULATOR STILL TO BE NEGOTIATED • INTEGRATION MANPOWER AVAILABLE • CO-LOCATED WITH LAUNCH SITE	

Summary of Physical Integration Preferences. The division preferences for physical (hardware) integration of attached payloads to the space station hardware are summarized in Table II-2. As shown in the first note of Table II-2, a comment of "PPS" in the "COMMENTS/ CONCERNS" column indicates a requirement for a Payload Pointing System (PPS); the PPS requires Attached Payloads Accommodation Equipment (APAE) and an Attitude Determination System (ADS) to go with it. Note that in many cases co-location with the project development team was a significant factor in the choice of the prime preferred physical location.

Earth Science and Applications (Code EE) Preferences. The representative payload for the Earth Science and Applications Division was the Eos (Earth observing system). The Eos program consists of primarily free-flying instrumented polar platforms which will undertake long-term studies of the solid, gaseous, and liquid Earth to obtain a detailed understanding of the separate and integrated physical, chemical, and biological processes of the planet. Some instruments, though, will be attached payloads on the the space station manned base.

The Earth Science and Applications Division chose GSFC as the prime physical integration location. The division representative argued that GSFC lends itself easily to this role, given its capabilities as outlined in Table II-1, and given GSFC's role in Eos development. Although KSC was listed as a backup location, it was felt that using KSC could result in increased cost, schedule, and technical risks. The representative pointed out the lack of environmental testing capability at KSC and argued that the some of the time available for development could be lost if the payloads had to be shipped elsewhere for integration. Many Eos payloads would require a PPS unit.

Solar System Exploration (Code EL) Preferences. Two candidate facility-class payloads were addressed by the Solar System Exploration Division:

(1) ATF (Astrometric Telescope Facility). This candidate telescope payload would make interferometric and astrometric measurements of extra-solar and solar system bodies, and would be used in long-term studies to detect new planetary systems.
(2) CDCF (Cosmic Dust Collection Facility). The 350 kg CDCF will determine orbital elements of individual cosmic dust particles, trap particles in the least degraded manner, and provide for the return of the collected particles, to Earth, together with the orbital information for their detailed analysis.

The Astrometric Telescope Facility would be developed off-site, with the Jet Propulsion Laboratory monitoring the activity. The preferred integration location for this payload was therefore the contractor location. KSC was listed as the backup site, with no particularly negative impact associated with this choice. End-to-end testing would be done at KSC if necessary.

The prime preferred physical integration location for CDCF is also at the development contractor's site. This site combines many facility integration activities at one location. The Solar System Exploration Division believed it would be more efficient to add these additional integration tasks to the contractor's efforts, which include experiment integration, than to ship CDCF elsewhere. In this case the project management location at JSC was not a consideration, and the backup choice was GSFC (because of its APAE/PPS knowledge base). It was assumed that appropriate facilities and manpower would be available at the contractor's site. While CDCF does not need the PPS, it still requires standard APAE, and it was preferred that the APAE be shipped to the contractor's location. The Solar System Exploration Division anticipates increased technical risk if the integration is performed at KSC.

Space Physics (Code ES) Preferences. The Space Physics Division considered five candidate payloads:

(1) Astromag. Astromag is a proposed 6000 kg superconducting magnet facility for the space station. Astromag will measure the properties of cosmic ray particles and will search for antimatter and exotic particles using magnetic spectrometers.
(2) STO/SIG (Solar Terrestrial Observatory/Solar Instrument Group). STO/SIG is a solar-viewing payload that will investigate solar activity and observe and study the physical processes that couple the solar-terrestrial system.
(3) STO/PIG (Solar Terrestrial Observatory/Plasma Instrument Group). STO/PIG is a solar-viewing payload that will study the Earth's magnetosphere by controlled perturbations of the environment for investigation of cause and effect mechanisms.

Table II-2. Attached Payload Physical Integration Preference by Division/Payload

DIV	PAYLOAD	PRIME PREFERRED PHYSICAL INTEGRATION LOCATION	BACKUP PREFERRED PHYSICAL INTEG. LOC.	COMMENTS/ CONCERNS	IMPACT TO OSSA IF AT KSC
EE	GENERIC (EOS)	GSFC	KSC	PPS	MORE $, MORE RISK
EL	ATF	CONTRACTOR LOCATION	KSC	PPS	
	CDCF	CONTRACTOR LOCATION	GSFC	APAE	MORE RISK
ES	ASTROMAG	GSFC	KSC	APAE, TRUSS EXTENSION	
	STO/SIG	KSC	GSFC	PPS	
	STO/PIG	MSFC	KSC	APAE	
	PIMS	KSC	SARR PROJECT OFFICE	SARR ADAPTER	
	SARR	SARR PROJECT OFFICE	SARR PROJECT OFFICE	SARR ADAPTER	SCHEDULE
EZ	LAMAR	GSFC	TBD	PPS / OTHER POINTER	MORE $, MORE RISK

NOTES: (1) PPS NOTE IMPLIES APAE AND ADS
(2) GENERAL CONCERN WITH KSC: NO ABILITY TO DO ENVIRONMENTAL TESTING

(4) SARR (Small and Rapid Response payloads). The SARR payloads are a class of payloads in the 100-500 kg, 1-2 m^3 category. They will enable high-priority specialized science and applications investigations while imposing minimal operational requirements on the space station.

(5) PIMS (Plasma Interaction Monitoring System). PIMS consists of 10-12 distributed, autonomous instrument packages, each having a mass of about 100 kg and a volume of $0.5m^3$. Each instrument will provide monitoring of the neutral, plasma, and particulate environments around the station and will measure the interactive effects between the station and this environment.

Minimizing the number of Centers involved in the integration process was a unifying theme in the choice of integration centers by the Space Physics Division.

Development of Astromag will proceed in-house at GSFC, which was chosen by the Space Physics as the prime preferred physical integration location (with KSC as backup). Project management, instrument integration, data flow verification/validation, and cryogenic tests all will be performed at GSFC. Functional test, end-to-end verification, and top-off of cryogenic helium will be performed at KSC. In addition to standard APAE, Astromag also requires a truss extension. Space Physics did not anticipate a strong impact to Astromag if integration were performed at KSC instead of GSFC.

KSC was chosen as the prime preferred physical integration site for STO/SIG because the requirement for a PPS favors KSC and (the backup site) GSFC—see Table II-1. It was assumed that STO/SIG does not require system level environmental testing at KSC, but will undergo normal processing. MSFC is the development Center and the location for instrument integration.

STO/PIG does not require a PPS, and the principle of minimizing the number of Centers involved suggests the development center, MSFC, as the prime preferred physical integration location. APAE interface integration can then take place at MSFC along with the instrument integration. Another advantage that MSFC has for this particular payload (and for all payloads where multiple, independent instruments share a common carrier) is an EMI test capability. KSC was chosen as the backup location, with no significant impact identified as a result of performing the physical integration there.

SARR payloads will originate in multiple development centers and will be attached to the space station truss by non-APAE equipment, referred to here as "SARR adapters." A support group to be located at one of the Centers, organized in an analogous manner to the sounding rocket and Get Away Special (GAS) projects, has been proposed to provide an essential single point interface between experimenters and the combined Space Station Freedom and STS organizations. This group, whose location is not yet determined, was designated by the Space Physics Division as the prime and backup preferred physical location. If the integration were performed at KSC, and KSC were not the site of the proposed SARR project office, a schedule impact could result.

The PIMS project, sometimes considered an element of the SARR activity, is in development at MSFC. The normal interface verification and test (IVT) at KSC is almost equivalent to physical integration in the case of PIMS. In the spirit of minimizing the number of involved Centers, KSC was recommended as the prime preferred physical integration location, with the SARR project office as the backup. PIMS units will be located on the corners of truss elements, and will use the same special "SARR adapter" mechanism that the SARR payloads will employ.

Astrophysics (Code EZ) Preferences. For workshop purposes, the Astrophysics Division chose LAMAR (Large Area Modular Array of Reflectors) as the only payload example for Astrophysics. LAMAR, a 10,000 kg celestial-viewing X-Ray telescope that will perform sensitive cosmic X-ray observations, is at the outside of the requirements envelope for Astrophysics payloads.

As a telescope, LAMAR will need a PPS or other pointer. The prime preferred physical integration location is GSFC, the development center. A backup location was not determined, and Astrophysics considered integration at KSC to entail additional expense and technical risk.

End-to-end Testing. End-to-end testing locations are not yet established, and users' definitions of end-to-end testing tend to vary. Participants in the attached payloads subgroup indicated that the testing should occur both early (to allow time to correct problems) and as late as possible (for thoroughness) in the flow.

Simulators. Presently only one space station PPS Simulator is scheduled to be available. It is planned to be located at GSFC. A PPS Simulator is planned for KSC, but funding is not specified. Other simulator hardware (e.g., APAE, deck carrier plates, mounting trusses, etc.) will also be required. These items are planned to be available at GSFC through WP-3.

Moving a PPS Simulator to the payloads versus moving the payload to the PPS Simulator also must be considered. Does use of a PPS by a payload indicate that GSFC should be the integration center?

Environmental Testing. Participants in this subgroup expressed a general concern with the lack of environmental testing facilities at KSC.

Compatibility Analysis. The question of where analytical compatibility analysis of multiple payloads (from multiple development centers) on one deck carrier should take place needs to be considered.

Pressurized Payload Integration Subgroup

In this subgroup, both Life Sciences and Microgravity Science and Applications outlined their integration preferences, described in the next two sections. Although the Divisions saw no technical reasons why the integration could not be performed entirely at KSC, both Divisions voiced concern about possible schedule and cost impacts, and about potential risk due to limited environmental testing in the final flight configuration.

The remaining paragraphs describe several issues which arose during this meeting and which are relevant to physical integration of payloads from Life Sciences and Microgravity Science and Applications

Life Sciences Division Integration Approach. The Life Sciences Division proposes to perform physical integration with flight racks at both ARC and JSC.

The non-human Life Sciences research is concentrated at ARC, where the required test and experiment verification activities must be done. Life Sciences representatives felt that a requirement to deintegrate and reintegrate in flight racks at KSC would duplicate effort, add in-line time at KSC, and increase the risk to flight hardware.

The human Life Sciences research at JSC requires close coordination and integrated management of a limited resource (crew time), as well as focused research programs (e.g., Space Biology) and operational support (e.g., extended duration crew operations, crew exercise, crew environment, and crew health). Life Science representatives advocated a payload integration center at JSC to permit minimum impact to astronaut time for crew-intensive activities, and to make use of the relevant facilities and expertise at JSC. They argued that the function of a payload integration center will be conducted as part of experiment development activities.

Microgravity Sciences and Applications Division (MSAD) Integration Approach. The Microgravity Science and Applications Division's approach to integration consists of the following:

(1) MSAD development centers would be certified to the minimum level that allows them to carry out physical integration of experiments (or facilities) to flight racks.
(2) A "full-up" integration center capability at KSC would carry out high fidelity interface verification and testing.
(3) MSAD proposes an initial integration capability at MSFC. Integration capabilities will increase over time at MSAD development centers based on priorities and budget availabilities.

The MSAD arguments for a distributed approach to physical integration were in many respects similar to those of the Life Sciences representatives. The MSAD representatives argued that their preferred approach would reduce hardware handling and associated risks, would make more time available to problem resolution in both the development and integration phases, and would minimize manpower and travel expenses for launch site integration activities.

Simulators. The Life Sciences Division requires high-fidelity simulators at JSC and ARC. The Microgravity Science and Applications Division requires lower fidelity simulation at the development centers to support payload functional tests, and additional simulation capability at KSC for final functional tests.

Both divisions agreed that a common design is preferable, and that station simulators should be provided by a single source as close to the Space Station Freedom Program systems/simulators as possible. Strict configuration management/control during design/development/use of simulators and Ground Support Equipment (GSE) must be maintained. The nature of the simulators and the number of simulators are continuing concerns.

Both Microgravity Science and Applications and Life Sciences intend to have operational ground versions of flight equipment for flight operations/troubleshooting support, training support, and future development, modification, and upgrade support.

Use of Spacelab Facilities by the Life Sciences Division and the Microgravity Science and Applications Division. Spacelab missions will continue to be flown during space station assembly and beyond. In general, because Spacelab will still be flying concurrently with the space station, no part of the Spacelab integration "line" can be used for the space station. Table II-3 contains a brief summary of the potential use of Spacelab facilities by Life Sciences and Microgravity Science and Applications.

Use of non-Spacelab Facilities. Facilities which are available or approved (in the C of F and R&D budgets) are found at KSC (the Space Station Processing Facility), JPL, JSC, MSFC (as available from WP-1), and LeRC. Facilities are being proposed for space station payloads at MSFC and ARC. The discipline representatives indicated that their requirements for proposed facilities are independent of whether or not they are used for flight rack integration. Space station payloads would be supported by facilities proposed for other or multiple purposes at JSC (Medical Operations Facility) and LeRC (the Space Experiments Laboratory).

Use of SSFP Capabilities/Contractors. There was some discussion about whether space station-funded capabilities and contractors could advantageously be made available to users (e.g., Life Sciences and Microgravity Sciences at WP-1). WP-1 has existing contract language to allow the integration of payloads. WP-3 has an option to integrate attached payloads. WP-4 at LeRC has not defined its integration role yet. Questions remain regarding the contention for contractor resources between the SSFP and payloads, and regarding funding responsibilities.

Traffic Model. Division plans indicate more payloads than those in the MUS allocated test mission set, and the MUS set in turn is not accommodated by the latest assembly sequence and trial payload manifest. OSSA planning for payload integration needs flexibility to respond to uncertainties in the manifest. In other words, planning should provide for an infrastructure that can evolve as flight opportunities and overall space station capabilities become better defined.

Table II-3. Use of Spacelab Facilities by Life Sciences and Microgravity

Johnson Space Center	JSC has off-line labs and general support equipment. No Spacelab facility or equipment is available for Space Station payloads use due to either inappropriateness or use for planned Spacelab missions. Space not dedicated to Spacelab is available.
Marshall Space Flight Center	Same as JSC.
Kennedy Space Center	KSC offers potential use of the Operations and Checkout (O&C) off-line labs and user rooms. They are not adequate for the increased loading at present. Use of payload processing facilities (Hangars AE, AO, AM, etc.), the Payload Hazardous Servicing Facility (PHSF), or the Spacecraft assembly and Encapsulation Facility (SAEF-2) are also possibilities. The Partial Payoad Checkout Unit (PPCU) may be available for functional testing of payloads.
Jet Propulsion Laboratory	N/A
Ames Research Center	Same as JSC.
Lewis Research Center	N/A

Partial Racks. The term "partial racks" refers to cases wherein separate payloads from different disciplines (e.g., life sciences and microgravity sciences) and/or from different development centers are integrated into a single flight rack. Both the Microgravity Science and Applications Division and the Life Sciences Division felt that such cases would be infrequent, but agreed to cooperate on multidiscipline racks composed of experiments from one Center. Microgravity Science and Applications did not want responsibility for integrating these multidiscipline racks, but Life Sciences was willing. For example, the Life Sciences management at Johnson Space Center's Life Sciences building (Building 36) would have no objection to integrating microgravity experiments provided they could fit it into their flow. For those racks containing experiments from multiple Centers, both divisions would prefer to have all integration done at one lead integration center. The alternative of moving the racks from Center to Center is undesirable.

Integration Capability for Other U.S. Users. NASA will have capability for payload integration available for other U.S. users such as NIH, NSF, USDA, etc. Payloads from other users were assumed to be integrated into appropriate OSSA discipline racks.

Costs. Many of the costs related to payload integration remain unknown, including the following:

(1) the cost of being certified by the Office of Space Station Freedom and maintaining certification;
(2) the cost associated with multiple integration sites versus a single site; and
(3) the long-term costs for maintaining integration capability/overhead.

Sub-rack Replacement. The procedures by which equipment can be replaced on-orbit below the full rack level are still undetermined.

Contractor Facilities. Both the Life Sciences Division and the Microgravity Science and Applications Division may use systems contractors off-site for payload integration, but did not feel strongly about establishing an integration center capability at contractor facilities. (Life Sciences did express an interest in having the facility where the centrifuge will be built certified as an integration center.)

Availability of Racks. Details to be addressed include the total number of racks, phasing of rack availability, and allocation of racks to the U.S. and international partners. There is uncertainty about whether the disciplines will have to provide their own unique racks (for the centrifuge, for example). There also is the question of whether the shipping containers and GSE/Handling equipment will be provided by the space station in sufficient quantities to satisfy payload requirements. A request from the Office of Space Science and Applications to the Office of Space Station Freedom for clarification is needed.

U.S. Hardware in International Racks. Procedural aspects of the integration of U.S. hardware into international (ESA or NASDA) racks are to be determined. They include location (KSC or elsewhere) of the integration activity, the nature of the certification requirements, and the availability of simulators and GSE for the international racks.

Integration Preference Summary.

In summary, Figure II-1 shows the original strawman integration architecture or point of departure for both attached and pressurized payloads. Figure II-2 shows the corresponding discipline-preferred integration architecture for both attached and pressurized payloads. Where specific payloads were used to arrive at discipline preferences, the payload name is shown beside the associated link in Figure II-2. These figures outline the views of the participants in the integration splinter groups.

Conclusions, remaining issues, and near-term actions for integration are found in Chapters 3 and 4.

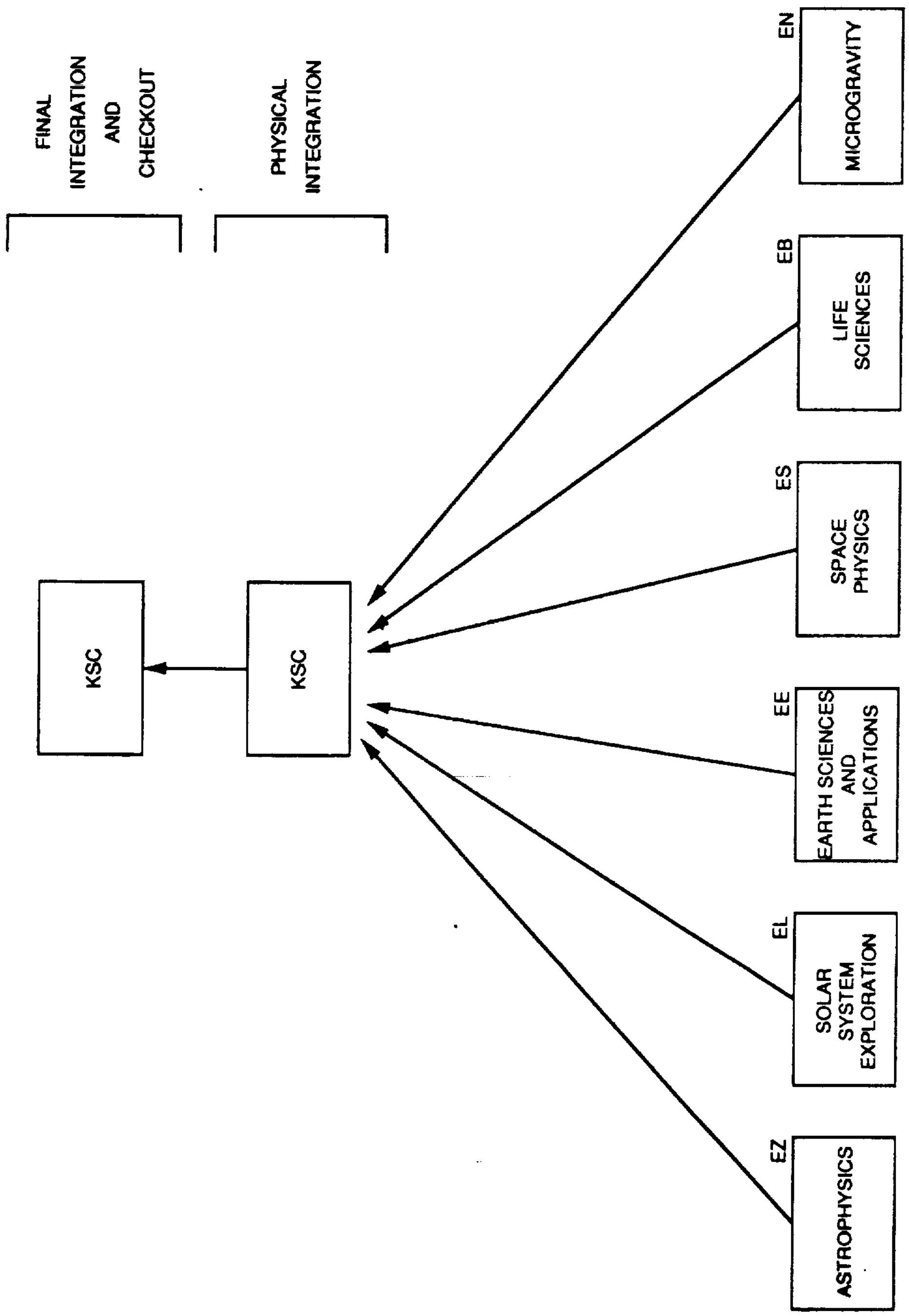

Figure II-1. Strawman Integration Architecture

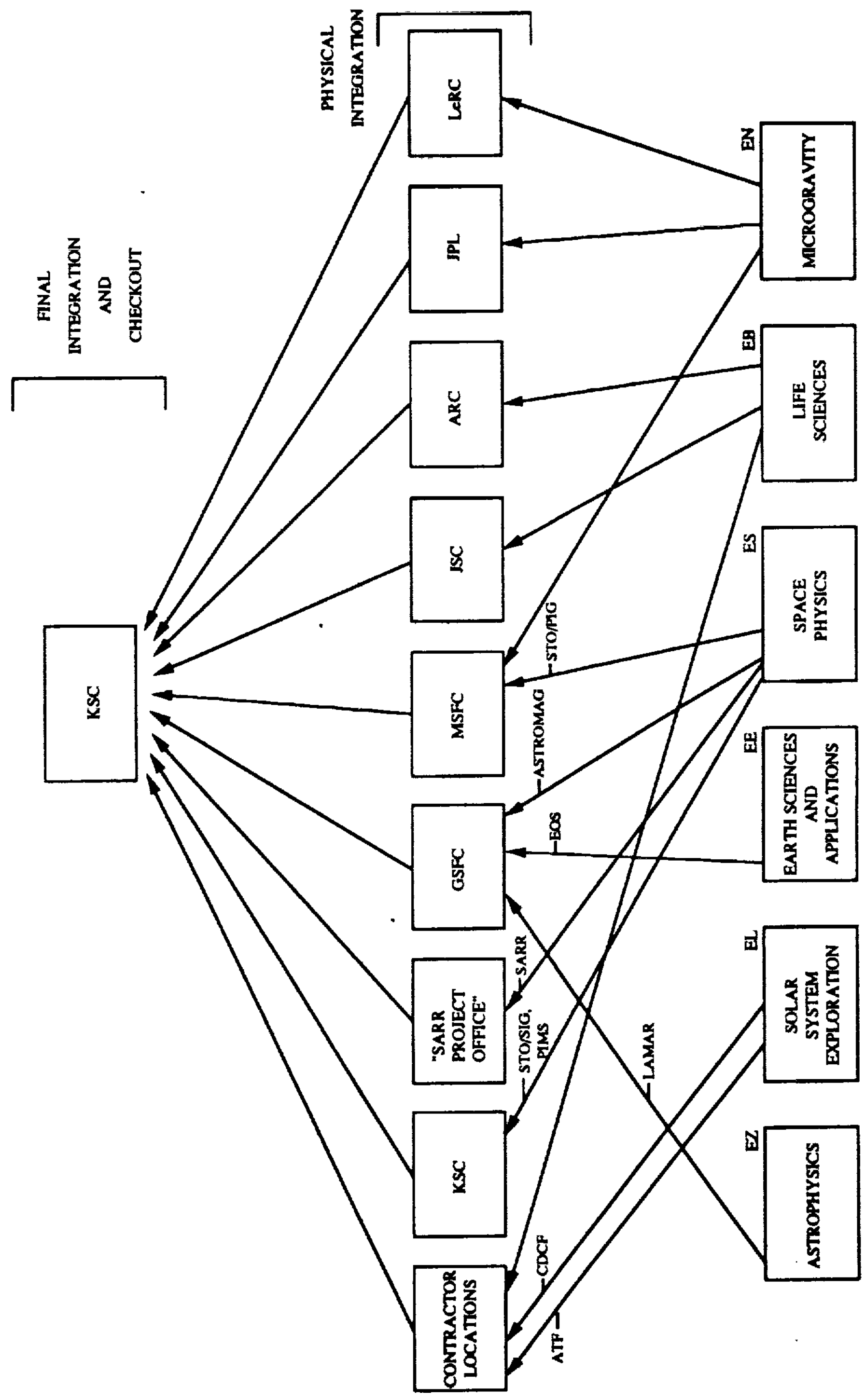

Figure II-2. Discipline-Preferred Integration Architecture

Operations

The Operations Splinter Group considered alternatives for payload operations centers, and aspects of data systems planning, with representatives of both areas in attendance.

Payload Operations Center Management Alternatives

The splinter meeting began with a discussion of the "Preliminary Payload Operations Responsibilities" chart (see Table II-4) presented during the preceding plenary session as a point of departure. The Operations Splinter Group discussed the assigned functional responsibilities shown in Table II-4, and suggestions were made for changes to the table. Further consolidations at "sites" are possible.

The Operations Splinter Group then addressed the nature and functions of the payload operations centers by discussing two organizational options for managing integrated science operations.

"Option A" (see Figure II-3) was similar to "preferred Option #6" in the SUM report in which the payload operations centers were grouped into two categories of "Attached Payloads" and "Pressurized Volume Payloads". These two categories would serve as a coordinating interface between the payload operations centers and the "Integrated Science Operations" management function to be performed by the SUM, which in turn would represent the interests of all payload operations centers to the POIC.

"Option B" (see Figure II-4) differed from Option A only in the absence of the Attached Payloads and Pressurized Volume Payloads management layers. It contained the same 13 operations centers found in Option A, a reduction from the number discussed at the Guntersville Workshop.

When Option A was discussed, a lengthy debate ensued during which the following arguments against this option were raised:

(1) It seems to proliferate a bureaucratic geographical separation of science operations management.
(2) All SSMB payloads are hosted on the same structure and share the same limited resources (e.g., crew time, power). Therefore, there is no need for an artificial separation of pressurized volume from attached payloads as is indicated in Option A.
(3) It imposes three cycles of resource allocation optimization (only one cycle is necessary).
(4) It would lead to turf battles between pressurized volume and attached payloads, would guarantee a "ping pong" effect of iterative "bottom-up"/"top-down" management reactions, and would set a bad example of non-cooperation to the other International Partners.
(5) There will be a tendency for padding resource allocations with "management reserves" which will be exacerbated by the increased number of sublevels of management in Option A.
(6) Real-time reallocation of SSMB resources to allow quick reaction to sudden transient science research opportunities (e.g., a volcano eruption or a supernova) may be impeded by the additional management level in Option A for grouping into pressurized volume and attached payloads.

As a result of this debate, each of the seven OSSA science discipline offices represented at the workshop had an opportunity to express its preferred payload operations center management structure. The management structures which were presented are shown in Figure II-5. Table II-5 provides additional supporting information concerning each discipline's preferences. These preferences are in agreement with the data matrices submitted to the workshop by the OSSA divisions (see Appendix C for details). The various management structures were then folded into the alternative Option B structure.

Participants preferred Option B. There was lengthy discussion on where the integrated science operations functions for OSSA payloads should be carried out: as part of the POIC or located in a separate facility.

PRELIMINARY PAYLOAD OPERATIONS RESPONSIBILITES

	POIC	INTEGRATED SCIENCE OPERATIONS	PAYLOAD OPERATIONS CENTERS	USERS
• GENERAL	- INTEGRATE ALL PAYLOAD OPNS. - MAINTAIN HEALTH & SAFETY OF COMMON PAYLOAD EQUIPMENT - OVERVIEW SAFETY & SECURITY FOR PAYLOADS	- INTEGRATE OSSA SCIENCE OPNS.	- INTEGRATE DISCIPLINE/ SUB-DISCIPLINE SCIENCE OPNS. - MAINTAIN HEALTH & SAFETY OF DISCIPLINE EXPTS. EQUIPMENT - MAINTAIN SAFETY & SECURITY FOR DISCIPLINE EXPTS.	- CONDUCT OWN OPNS. - SUPPORT HEALTH & SAFETY OF EXPT. EQUIPMENT - SAFETY & SECURITY FOR SELF
• MISSION PLANNING	- PROVIDE MISSION PLAN. SYSTEM - INTEGRATE THE PAYLOAD MISSION PLAN - INTEGRATE SYSTEM RESOURCE/ SERVICE REQUIREMENTS - DEVELOP TIMELINES - ESTABLISH PAYLOAD RESOURCE ALLOCATIONS - INTEGRATE TARGETING OPPORTUNITIES - INTEGRATE PAYLOAD DATA REQTS	- INTEGRATE OSSA MISSION PLAN - INTEGRATE OSSA RESOURCE/ SYSTEM REQTS. - DEVELOP TIMELINES - ESTABLISH DISCIPLINE SUB-ALLOCATIONS - INTEGRATE TARGETING REQTS. - INTEGRATE DATA REQTS.	- INTEGRATE DISCIPLINE MISSION PLAN - INTEGRATE DISCIPLINE RESOURCE SYS. REQTS. - DEVELOP TIMELINES - ESTABLISH USER SUB-ALLOCATIONS - INTEGRATE TARGETING REQTS. - INTEGRATE DATA REQTS.	- PROVIDE USER REQTS. - DEVELOP TIMELINES - DEFINE TARGETS - DEFINE DATA REQTS.
• MISSION EXECUTION	- INTERFACE WITH SSCC - EVAL. & MANAGE P/L COMMON SYS. - CONTROL CREW PROC. MAINT. - MONITOR SYS. PERFORMANCE AFFECTING P/Ls - MANAGE CREW COM. - MANAGE UPLINK TRA FFIC - MANAGE PAYLOAD OMS - MANAGE PAYLOAD DATA FLOW - MANAGE STOWAGE OF P/L ITEMS	- ADJUST OSSA PRIORITIES/ RESOURCES ALLOCAT. REQTS. - MANAGE OSSA DATA FLOW	- MONITOR & CONTROL HEALTH & SAFETY OF DISCIPLINE EXPTS. - OPERATE EXPTS. WITHIN ALLOCATED RESOURCES - DEVELOP CREW PROCEDURES - CONDUCT CREW COM. - PERFORM UPLINK CMDS. - MANAGE DISCIPLINE DATA - TRACK STOWAGE FOR DISC. EXPTS.	- SUPPORT HEALTH & SAFETY OF EXPTS. - OPERATE EXPTS. WITHIN ALLOCATIONS - DEVELOP CREW PROCS. - CONDUCT CREW COM. - PERFORM UPLINK CMDS. - MANAGE USER DATA - INPUT TO STOWAGE MGT.

Table II-4. Preliminary Payload Operations Responsibilities

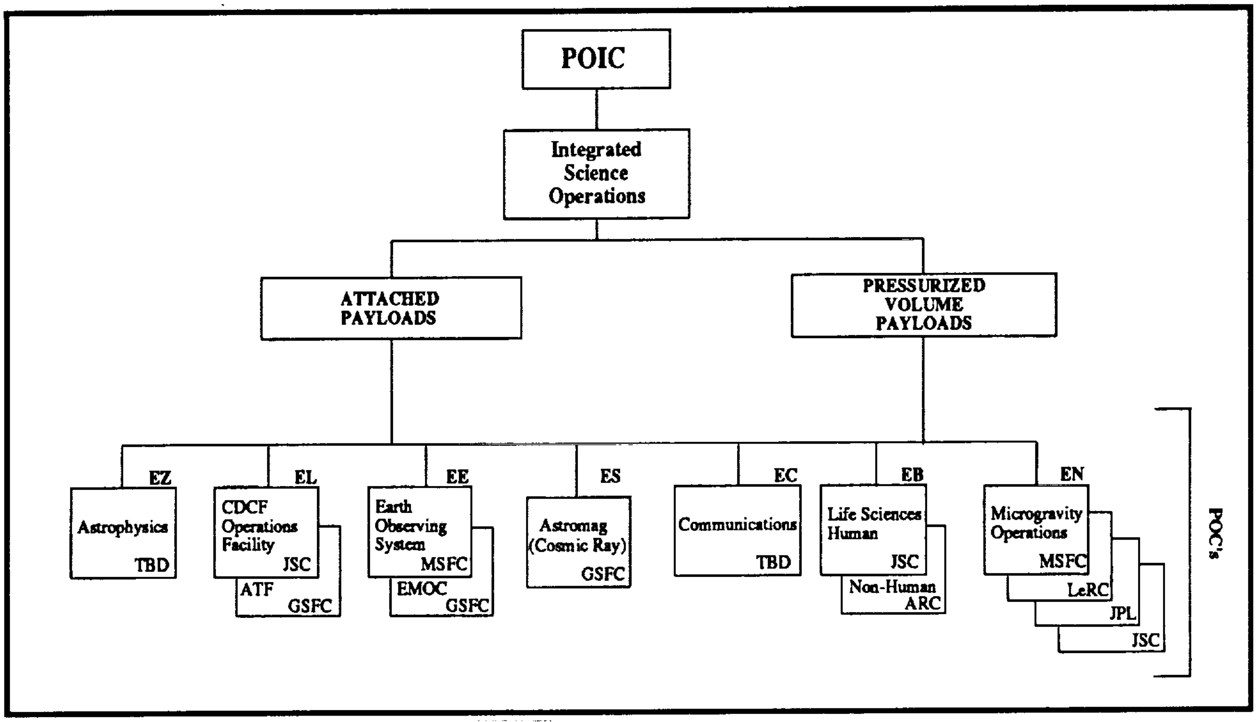

Figure II-3. Option A: Operations with Attached/Pressurized Coordinated Interface

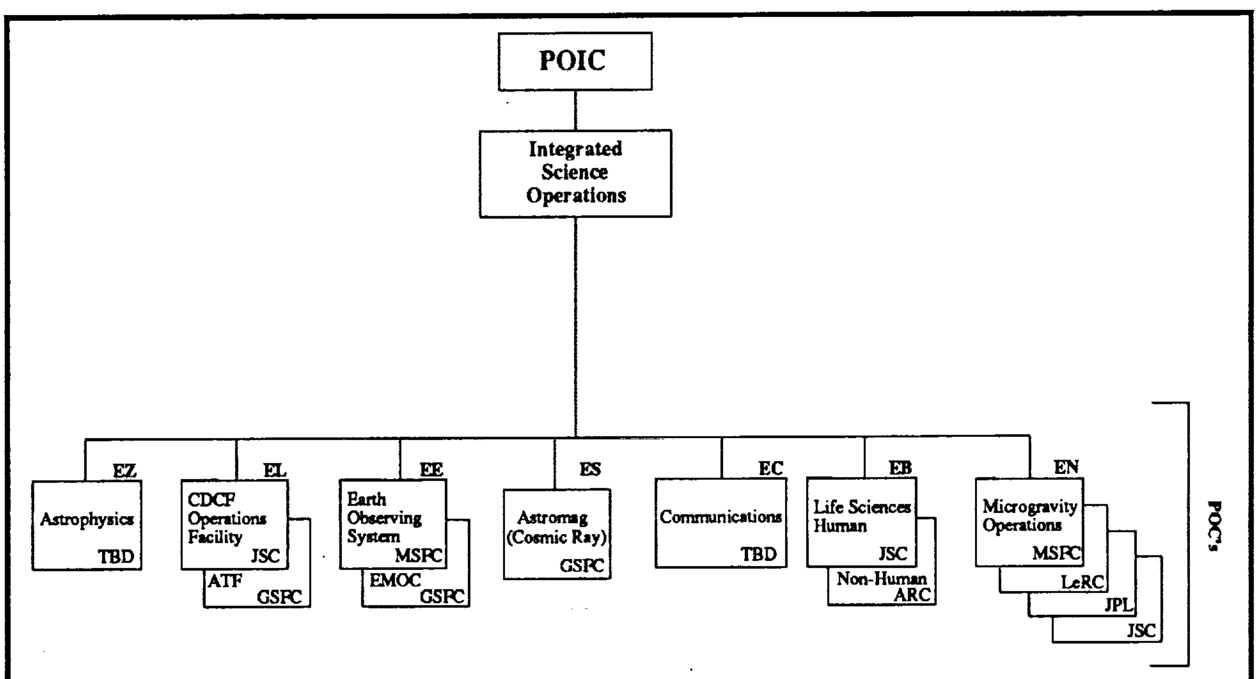

Figure II-4. Option B: Operations without Attached/Pressurized Coordinated Interface

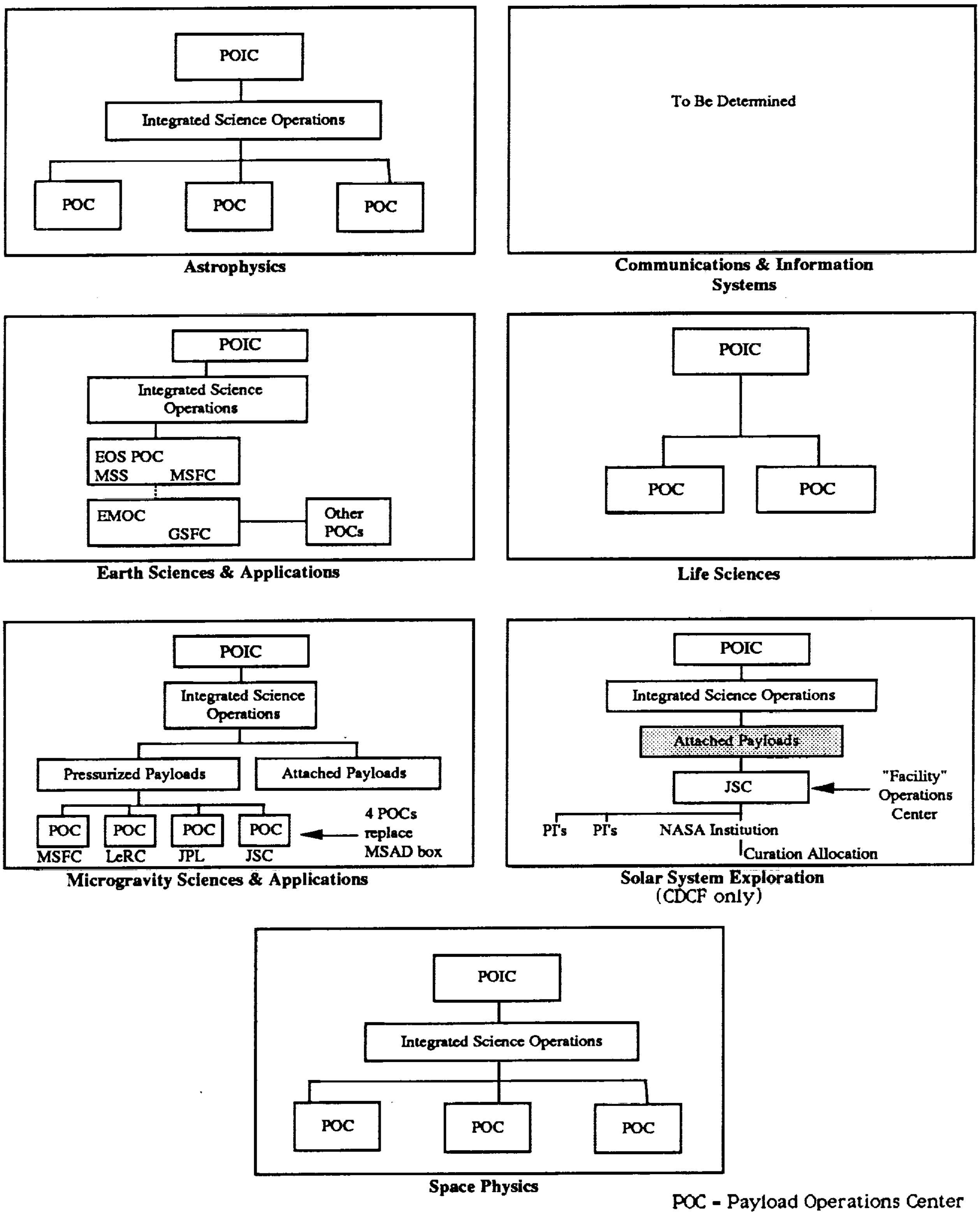

Figure II-5. Preferred Division Organizational Structures

Table II-5. OSSA Discipline Preferences for Managing Payload Operations Centers

OSSA DISCIPLINE/CODE	POSITION ON "ATTACHED/PRESSURIZED" MANAGEMENT OF POCs	SOURCE OF FUNDING FOR POCs	OTHER ISSUES
LIFE SCIENCES (EB)	DOES NOT FAVOR GROUPING POCs INTO "ATTACHED" AND "PRESSURIZED VOLUME" CATEGORIES	CODE EB	• TWO SEPARATE POCs AT JSC AND ARC • POIC HAS PROPER AND APPROPRIATE SCIENCE REPRESENTATION (i.e., COMBINES FUNCTIONS OF ATTACHED P/Ls, PRESSURIZED AND INTEGRATED SCIENCE P/Ls)
COMMUNICATIONS AND INFORMATION SYSTEMS (EC)	TBD	TBD	TBD
EARTH SCIENCE AND APPLICATIONS (EE)	NO NEED TO SEPARATE MANAGEMENT OF POCs FOR "ATTACHED" AND "PRESSURIZED VOLUME" PAYLOADS	CODE EE	• SSMB EOS POC AT MSFC • EOS MISSION OPERATIONS CENTER (EMOC) AT GSFC
SOLAR SYSTEM EXPLORATION (EL)	TBD (SEPARATION BETWEEN "ATTACHED" AND "PRESSURIZED VOLUME" PAYLOAD POCs HAS ADVANTAGES)	CODE EL	• RELATIVELY INDEPENDENT FACILITY OPERATIONS CENTER PLANNED AT JSC FOR CDCF EXPERIMENT
MICROGRAVITY SCIENCE AND APPLICATIONS (EN)	NO OBJECTION TO SEPARATE MANAGEMENT OF "ATTACHED" AND "PRESSURIZED VOLUME" PAYLOAD POC's	CODE EN	• ORIGINAL POC AT MSFC • "ATTACHED PAYLOAD" POC NOT BASELINED • PLAN TO USE "TELESCIENCE" WITH REMOTE USERS
SPACE PHYSICS (ES)	NO SEPARATION OF "ATTACHED" AND "PRESSURIZED VOLUME" PAYLOAD POC MANAGEMENT DESIRED	CODE ES	• POC AT GSFC INITIALLY FOR ASTROMAG WITH ALLOWANCE FOR GROWTH TO ACCOMMODATE OTHER FUTURE COSMIC RAY EXPERIMENTS
ASTROPHYSICS (EZ)	DOES NOT FAVOR GROUPING POCs INTO "ATTACHED" AND "PRESSURIZED VOLUME" CATEGORIES	CODE EZ	• INITIALLY AT LEAST 1 POC AT TBD LOCATIONS • AT LEAST 1 MORE POC ADDED LATER AT TBD LOCATIONS

POC = Payload Operations Center

Data Systems Planning

Another important issue discussed by the Operations Splinter Group related to data systems planning. The OSSA Communications and Information Systems Division elicited suggestions from science disciplines centered around the four topics of "data capture", "data processing", "data archiving", and "external communications".

Data Capture. The following issues were raised regarding the "data capture" aspect of this discussion:

(1) Beyond the 20 Mbps committed by the Office of Space Operations, does OSSA intend to fulfill the science user requirements for Level 0 Processing (LZP) and associated 7-day storage capability itself, or does it expect Office of Space Station Freedom or Office of Space Operations to fulfill it?
(2) Where is the optimum location to accomplish this LZP activity?

Data Processing. Considerable discussion arose relative to data processing. Will "data processing" be accomplished exclusively within payload operations centers?

Data Archiving. The following three items were discussed relative to the "data archiving" aspect of data processing:

(1) What will be the nature of the connection of payload operations centers into discipline data archives?
(2) What costs will be incurred for data archiving functions?
(3) What volume of data will be archived?

External Communications. Many of the OSSA disciplines represented at the meeting expressed an expectation that the Office of Space Operations will perform all necessary "data capture"operations for science users, including providing "Level Zero Processing (LZP). The Office of Space Operations has committed to providing 20 Mbps aggregate LZP within a 24-hour turnaround time, with the possibility of growth as approved requirements are manifested. (The meaning of "20 Mbps aggregate" requires clarification in this context.) OSSA issues raised during the meeting include:

(1) What would be the time delay associated with one centrally located remote high data rate (e.g., 300 Mbps) LZP facility?
(2) What will be the turnaround time at LZP facilities, including the necessity for providing a "quick-look" capability?
(3) What would be the impact of implementing an option of providing LZP at multiple OSSA facilities with the possibility of the Office of Space Operations providing algorithms and/or hardware while OSSA provides operations support?

In order for the Office of Space Operations to proceed with "forward link" implementation, group members suggested that the Office of Space Station Freedom needs to define "command" requirements for:

(1) A payload command security, privacy, and management concept, and
(2) An implementation concept.

The group also recommended that OSSA should review the Office of Space Station Freedom command implementation concept and its own "latency" requirements. Another recommendation was that OSSA needs to determine locations for issuing payload commands so that NASCOM requirements (e.g., security) can be levied upon the Office of Space Operations and the associated funding considerations can be determined. (This issue is currently being worked via revisions to the Software Requirements Document.)

Comparison of Workshop Results with Expected Products

The anticipated workshop products listed on Page I-7 were attained in varying degrees. In particular:

(1) Functional requirements for both integration and operations were obtained. Appendix C contains the functional requirements as listed by the disciplines. These functional requirements have not yet been consolidated.

(2) Existing capabilities were identified and compared with discipline needs as previously discussed in this chapter.

(3) Issues associated with payload integration center and payload operations center development were identified; they are summarized in Chapter IV.

(4) The workshop identified initial options for operations and integration. Data to develop integrated options (see, for example "Option B" on Page II-14) have been obtained.

Chapter III: Conclusions

The three primary conclusions of the workshop are as follows:

(1) While there are no technical reasons that would preclude using KSC as the site for all payload integration, the science and applications disciplines strongly prefer in most cases to carry out physical integration at the payload development sites. However, resource and budgetary considerations could affect the site selection. The disciplines' arguments in support of distributed integration capabilities centered on themes of reduced cost, schedule, and technical risk, and increased "user friendliness."

(2) The OSSA disciplines prefer to have distributed discipline-oriented operations.

(3) The OSSA science disciplines do not want an extra management layer to divide payload operations into attached and pressurized categories. Thus the operations baseline model will not include separate organizations for attached and pressurized payloads. Scientists want more direct access into the decision-making process, particularly for the mission planning/resource allocation functions.

Chapter IV: Issues and Actions

This chapter summarizes specific issues that the workshop addressed, but could not resolve. They are categorized according to whether they are integration, operations/data systems, or general issues. In addition, subsequent near-term actions to be taken are shown.

Issues

General

(1) Who will be responsible for funding payload integration centers and payload operations centers?

(2) Certification requirements imposed by the Space Station Freedom Program must be better defined before the full impact can be assessed.

(3) The Flight Systems Division and the Communications and Information Systems Division appear to have overlapping responsibilities. The nature of the responsibilities for each organization needs to be clarified.

(4) The number of simulators available, their fidelity, their source, how they will be used, and when they will be used are continuing concerns.

(5) Although a consensus was reached on the need for a SARR Project Office, the location and establishment of the SARR Project Office and a SARR attached payload integration site must be determined.

Integration

(1) Will the WP-1 integration capability be available for pressurized payloads to be launched with the U.S. Laboratory and on the first outfitting flight? Will this capability be available to support integration of other payloads? Is it feasible to transfer this capability subsequently to OSSA control?

(2) How will integration centers for pressurized payloads be able to maintain their certification after the U.S. Laboratory hardware is in orbit? What sort of certification will be required, if any? Does the certification vary with the degree of physical integration required (e.g., "certification by the yard")? Is there a minimum feasible certification required?

(3) The life sciences requirement for having several racks fully integrated prior to launch to enable high fidelity simulation is inconsistent with the currently planned assembly sequence. Some of the racks required for the high fidelity simulation will be on orbit while others are on the ground.

(4) The number, characteristics, and availability of space station racks and associated GSE are not known. OSSA needs information from the Office of Space Station Freedom on the number, type, and availability of U.S. racks to be provided. Similar "hard" information about ESA and NASDA racks is also needed.

(5) There are still questions regarding how much help will be available through existing space station work packages.

(6) Division plans indicate more payloads than those in the MUS allocated test mission set, and the MUS set in turn is not accommodated by the latest assembly sequence and trial payload manifest. OSSA planning for payload integration needs flexibility to respond to uncertainties in the manifest. In other words, planning should provide for an infrastructure that can evolve as flight opportunities and overall space station capabilities become better defined.

(7) End-to-end testing requirements and locations are not yet established.

(8) Should the PPS Simulator be moved to the payloads, or should the payloads be taken to the PPS Simulator?

(9) There is a general concern about the lack of environmental testing capability at KSC.

(10) Where should analytical compatibility analysis take place for multiple payloads (from multiple development centers) on one deck carrier?

(11) How should partial racks be handled, and what is the level of activity associated with them?

(12) The process by which equipment can be replaced on orbit at the sub-rack level must be defined. The nature of the associated certification, if any, is also undetermined.

(13) What are the procedures and consequences of certifying non-NASA facilities for integration?

(14) Will integration of U.S. hardware into international racks take place at KSC, or can it be done elsewhere? What are the certification requirements? Will simulators and GSE be available for the international racks?

Operations/Data Systems

(1) What is the time phasing for bringing on-line the OSSA science operations capabilities, including the payload operations centers, from the present through space station steady state operations?
(2) The disciplines want to staff the integrated science operations elements and the POIC with scientists who are associated with user payloads. How does OSSA identify the detailed functions necessary to perform these tasks?
(3) There is concern regarding resource control and allocation.
(4) How are the responsibilities for Level Zero Processing (LZP) distributed?
(5) What is the flow of data from the payload operations centers into discipline or data archives?
(6) Present Office of Space Operations data system plans are not sufficient to meet science data handling requirements.
(7) User latency requirements need to examined in more detail.

Near-term Actions

General

(1) The results of the post-workshop analysis should be merged with SUM planning.

Integration

(1) More definitive information needs to be obtained on the rack integration capabilities and schedules that WP-1 may have in place to carry out U.S. Laboratory Module integration at MSFC. How and when might these capabilities be transformed subsequently into an OSSA-supported integration center?
(2) Certification requirements for integration centers need to be firmly established. Identification of the resources needed to establish and maintain certified integration capabilities will be a key factor in determining whether, or to what extent, a given experiment development site should also carry out physical integration with systems flight hardware.
(3) For each major development center, the disciplines need to work with the Flight Systems Division to quantify in approximate terms the flow and phasing of payload activity leading up to physical integration and associated test and verification activities. This quantification needs to address initial requirements (e.g., leading up to a fully populated space station by the end of the assembly sequence) as well as recurring requirements. This assessment must be consistent with the allocations of on-orbit resources and transportation/logistics services that can be reasonably expected.

Operations/Data Systems

(1) Define, in detail, the overall OSSA integrated science operations concept. Use the concept to identify the operations capabilities needed through space station steady state operations.
(2) Establish the detailed functional requirements for each hierarchical level of science operations planning and operations identified in the workshop.
(3) Develop a strawman data systems architecture for OSSA science operations which includes interfaces with the data systems planned by the Office of Space Operations and the Office of Space Station Freedom.

Appendix A: Abbreviations and Acronyms

ACUC	Animal Care and Use Facility
ALF	Acoustic Levitator Furnace
APAE	Attached Payload Accommodations Equipment
APCGF	Advanced Protein Crystal Growth Facility
ASTROMAG	(Not an acronym)
ATF	Astrometric Telescope Facility
BRP	Biological Research Project
CDCF	Cosmic Dust Collection Facility
CITE	Cargo Integrated Test Equipment
Code EB	Life Sciences Division
Code EC	Communications and Information Systems Division
Code EE	Earth Science and Applications Division
Code EM	Flight Systems Division
Code EN	Microgravity Science and Application Division
Code ES	Space Physics Division
Code EZ	Astrophysics Division
DDM	Drop Dynamics Module
DPM	Drop Physics Module
DOC	Discipline Operations Center
EMI	Electromagnetic Interference
EMOC	EOS Mission Operations Center
EMTC	Early Man-Tended Configuration
EOS	Earth Observing System
Eos	(See EOS)
ESA	European Space Agency
FEL	First Element Launch
FP/DP	Fluid Physics/Dynamics Facility
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
IFSUSS	International Forum on Scientific Uses of the Space Station
ISO	Integrated Science Operations
IVT	Interface Verification and Test
JEM	Japanese Experiment Module
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
JSUS	Joint Science Utilization Study
KSC	Kennedy Space Center
LAMAR	Large Area Multiple Array of Reflectors

LeRC	Lewis Research Center
LSE	Laboratory Support Equipment
LZP	Level Zero Processing
MCF	Microgravity Combustion Facility
MCPF	Modular Containerless Processing Facility
MSAD	Microgravity Science and Applications Division
MSFC	Marshall Space Flight Center
MUS	Multilateral Utilization Study
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications (network)
NASDA	National Space Development Agency (Japan)
NIH	National Institutes of Health
NSF	National Science Foundation
OSSA	Office of Space Science and Applications
PIA	Payload Interface Adapter
PIMS	Plasma Interaction Monitoring System
PMC	Permanently Manned Configuration
POC	Payload Operations Center
POIC	Payload Operations Integration Center
SARR	Small and Rapid Response
SIA	Station Interface Adapter
SS	Space Station
SSFF	Space Station Furnace Facility
SSFP	Space Station Freedom Program
SSMB	Space Station Manned Base
SSOTF	Space Station Operations Task Force
SSPF	Space Station Processing Facility
SSSAAS	Space Station Science and Applications Advisory Subcommittee
SSSAUP	Space Station Science and Applications Utilization Plan
SSSOMC	Space Station Science Operations Management Concepts
STO/PIG	Solar Terrestrial Observatory/Plasma Instrument Group
STO/SIG	Solar Terrestrial Observatory/Solar Instrument Group
STS	Space Transportation System
SUM	Science Utilization Management
USDA	United States Department of Agriculture
USML	United States Microgravity Laboratory
WP	Work Package

Appendix B
Agenda

OSSA PAYLOAD INTEGRATION/PAYLOAD OPERATIONS CENTER WORKSHOP

FINAL AGENDA

TUESDAY, DECEMBER 6, 1988:

1:30 -	REGISTRATION BEGINS	

EXECUTIVE SESSION

2:00 - 5:00	MEET WITH SPLINTER GROUP LEADERS	
	REVIEW OF AGENDA	
	RECAP GOALS/OBJECTIVES/PRODUCTS	
	INSTRUCTIONS	
5:00 - 6:30	BREAK FOR DINNER	

PLENARY SESSION

6:30 - 6:40	WELCOME/INTRODUCTION	E. REEVES
6:40 - 6:55	WORKSHOP AGENDA AND SCOPE	E. MONTOYA
6:55 - 7:10	ISSP STATUS	J. BREDEKAMP
7:10 - 7:30	SSOTF RECOMMENDED CONCEPTS	R. CLARK
7:30 - 7:50	RECOMMENDATIONS FROM OSSA REVIEWS (SSSOMC, SSOTF REVIEW, SSSAUP)	P. CRESSY
7:50 - 8:10	SUM MODEL FOR END-TO-END PAYLOAD FLOW	G. WICKS
8:10 - 8:30	ESA- COLUMBUS INT/OPS CONCEPTS	R. JONSSON
8:30 - 8:50	NASDA- JEM INT/OPS CONCEPTS	K. SHIBUKAWA
8:50 - 9:00	RECAP/INFO FOR TOMORROW	E. MONTOYA

WEDNESDAY, DECEMBER 7, 1988:

PLENARY SESSION

7:30 - 8:00	COFFEE/PASTRIES	
8:00 - 8:30	INTEGRATION - APPLICATION OF SHUTTLE/SPACELAB EXPERIENCE TO SPACE STATION	B. HEUSER
8:30 - 9:00	OPERATIONS - APPLICATION OF SHUTTLE/SPACELAB EXPERIENCE TO SPACE STATION	F. KURTZ
9:00 - 9:30	POIC CONCEPTS/PLANS	F. KURTZ
9:30 - 9:45	NETWORKS/DATA DISTRIBUTION	J. KILPATRICK
9:45 - 10:00	BREAK	
10:00 - 12:00	OVERVIEW OF CURRENT INTEGRATION AND OPERATIONS CENTER PLANS/CONCEPTS FOR SUPPORT OF SPACE STATION ERA SCIENTIFIC PAYLOADS	
	PRESSURIZED PAYLOADS	EN/EB
	ATTACHED PAYLOADS	EZ/ES/EL/EE
12:00 - 12:05	RECAP WORKSHOP APPROACH	E. MONTOYA
	SUMMARY INSTRUCTIONS ROOM ASSIGNMENTS	
12:05 - 1:00	LUNCH	

WEDNESDAY, DECEMBER 7, 1988:

OPERATIONS SPLINTER GROUP

1:00 - 1:15	INTRODUCTION	T. RECIO
1:15 - 2:15	OPERATIONS CENTER - POINT OF DEPARTURE	F. KURTZ
2:15 - 2:30	NETWORKS/DATA DISTRIBUTION CONCEPTS	J. KILPATRICK
2:30 - 2:45	BREAK	
2:45 - 4:30	PAYLOAD OPERATIONS CAPABILITIES PRESENTLY SUPPORTING SHUTTLE/SPACELAB	
	ARC	J. DYER
	GSFC	C. DUNKER
	JSC (SMA)	R. PATTERSON
	JPL	H. FITZHUGH
	KSC	P. HOUSTON
	MSFC	F. KURTZ
6:00 - 6:15	RECONVENE	T. RECIO
6:15 - ?:??	REVIEW/REVISE DIVISION'S FUNCTIONAL AND CONNECTIVITY REQUIREMENTS AS PRESENTED WEDNESDAY MORNING	EB/EN/EZ/EL ES/EE/OTHERS

WEDNESDAY, DECEMBER 7, 1988:

INTEGRATION SPLINTER GROUP

1:00 - 1:15	INTRODUCTION	B. HEUSER
1:15 - 2:15	INTEGRATION CENTER - POINT OF DEPARTURE	B. HEUSER
2:15 - 2:30	CERTIFICATION REQUIREMENTS	R. TILLEY
2:30 - 2:45	BREAK	
2:45 - 4:30	PAYLOAD INTEGRATION CAPABILITIES PRESENTLY SUPPORTING SHUTTLE/SPACELAB	
	ARC	J. GIVENS
	GSFC	J. GERVIN/ J. STECKER
	JSC (SMA)	L. KALLA
	JPL	B. WHITE
	KSC	D. WEBB
	MSFC	G. WICKS/ A. SLEDD
	LeRC	
6:00 - 6:15	RECONVENE	B. HEUSER
6:15 - ?:??	REVIEW/REVISE DIVISION'S FUNCTIONAL AND CONNECTIVITY REQUIREMENTS AS PRESENTED WEDNESDAY MORNING	EB/EN/EZ/EL ES/EE/OTHERS

THURSDAY, DECEMBER 8, 1988:

OPERATIONS SPLINTER GROUP

8:00 - 8:10	ANNOUNCEMENTS	T. RECIO
8:10 - 9:45	PRESENT COMPOSITE OPERATIONS CENTER CONCEPTS AND DISCUSSION	T. RECIO
9:45 - 10:00	BREAK	
10:00 - 11:30	OSSA DISCIPLINE EVALUATION/REACTIONS	
	PRESSURIZED PAYLOADS ATTACHED PAYLOADS	EN/EB EZ/ES/EL/EE
11:30 - 12:00	INFORMATION SYSTEMS/NETWORK REACTION	J. KILPATRICK
12:00 - 1:00	LUNCH	
1:00 - 1:10	APPROACH TO AFTERNOON SESSION	T. RECIO
1:30 - 4:30	OSSA DIVISIONS — DEVELOP/JUSTIFY LOCATION AND CONNECTIVITY OPTIONS	
	PRESSURIZED PAYLOADS ATTACHED PAYLOADS	EN/EB EZ/ES/EL/EE
4:30 - 7:00	BREAK FOR DINNER	
7:00 - ?:??	OSSA JOINT EXECUTIVE SESSION PAYLOAD INTEGRATION CENTER AND PAYLOAD OPERATIONS CENTER OPTIONS	P. CRESSY/ J. BREDEKAMP

THURSDAY, DECEMBER 8, 1988:

INTEGRATION SPLINTER GROUP

8:00 - 8:10	ANNOUNCEMENTS	B. HEUSER
8:10 - 9:45	PRESENT COMPOSITE INTEGRATION CENTER CONCEPTS AND DISCUSSION	B. HEUSER
9:45 - 10:00	BREAK	
10:00 - 11:30	OSSA DISCIPLINE EVALUATION/REACTIONS	
	PRESSURIZED PAYLOADS ATTACHED PAYLOADS	EN/EB EZ/ES/EL/EE
11:30 - 12:00	INFORMATION SYSTEMS/NETWORK REACTION	J. HARVEY
12:00 - 1:00	LUNCH	
1:00 - 1:10	APPROACH TO AFTERNOON SESSION	B. HEUSER
1:30 - 4:30	OSSA DIVISIONS — DEVELOP/JUSTIFY LOCATION AND CONNECTIVITY OPTIONS	
	PRESSURIZED PAYLOADS ATTACHED PAYLOADS	EN/EB EZ/ES/EL/EE
4:30 - 7:00	BREAK FOR DINNER	
7:00 - ?:??	OSSA JOINT EXECUTIVE SESSION PAYLOAD INTEGRATION CENTER AND PAYLOAD OPERATIONS CENTER OPTIONS	P. CRESSY/ J. BREDEKAMP

FRIDAY, DECEMBER 9, 1988:

PLENARY SESSION

8:00 - 8:10	ANNOUNCEMENTS	E. MONTOYA/ S. MCMAHON
8:10 - 8:50	SUMMARY OF INTEGRATION SPLINTER GROUP ACTIVITIES AND DISCUSSION	B. HEUSER
8:50 - 9:30	SUMMARY OF OPERATIONS SPLINTER GROUP ACTIVITIES AND DISCUSSION	T. RECIO
9:30 - 9:45	BREAK	
9:45 - 10:45	INTEGRATION CENTER OPTIONS	D. STOUGHTON
10:45 - 11:45	OPERATIONS CENTER OPTIONS	E. MONTOYA
11:45 - 12:00	ISSUES/ACTIONS	E. MONTOYA/ S. MCMAHON
12:00 - 1:00	LUNCH	
1:00 - 4:00	EXECUTIVE SESSION	
	TOPICS FOR DISCUSSION/REVIEW: INTEGRATION CENTERS SUMMARY OPERATIONS CENTERS SUMMARY INFORMATION SYSTEMS SUMMARY CONSOLIDATION OF RESULTS REPORT FORMAT/SCHEDULE ISSUES/ACTIONS	E. REEVES P. CRESSY J. BREDEKAMP E. MONTOYA D. STOUGHTON S. MCMAHON T. RECIO B. HEUSER G. WICKS W. EATON G. ANIKIS G. MUSGRAVE R. KINSLEY

Appendix C: Functional Worksheets

This appendix contains the preliminary functional worksheets used by the Disciplines to provide initial input to the workshop.

Prior to this workshop, there had been no organized attempt by OSSA to identify the requirements of each of its Divisions for establishing and maintaining Payload Integration Centers and Payload Operations Centers. Indeed, no uniform concept either for the distribution of Payload Integration and Payload Operations Centers or for the distribution of the functions performed by the Centers existed.. Strawmen architecures based on the Spacelab experience in intergration and operations were provided to each Division office. The Space Station planner for each Division was asked to review and modify the strawman according to the state of his Division's plans. The results as originally submitted to the workshop are found in this appendix.

It is important to note that the data presented here represent initial information to the workshop and do not reflect changes made by the Discipline representatives during the workshop.

The instructions which accompanied the worksheet send to each planner were as follows:

(1) The "Functions/Services" column should be reviewed for applicability to the support the Division's payload requirements for both, Payload Integration Centers, and for Payload Operations Centers. If "Functions/Services" required are not listed, then they should be inserted in the spaces provided . Those not required should be deleted.
(2) With regard to the column entitled "Strawman Location", KSC is to be considered the point of departure for Payload Integration Center activities, as is MSFC for Payload Operations Center activities (attached payloads) and JSC for Payload Operations Center activities (pressurized payloads). That is to say, if insufficient justification for conducting these activities at an alternate location can be provided, then the point-of-departure locations will prevail. For each Function/Service listed, fiscal, scientific, engineering, or other impact to payload(s) should be evaluated when considering the activity at some site other than that specified by the strawman.
(3) Should significant negative impact to the payload(s) develop as the result of conducting any particular Function/Service at the point-of-departure location, the location(s) that would result in minimum impact to thepayload(s) should be listed in the "Distribution" column. The location chosen does not have to be restricted to a NASA field center.
(4) Should a preference for distributing the Functions/Services at sites other than stated by the point-of-departure, the preference must be accompanied by strong and thorough justification.

An index to the contents of this appendix is provided on the following page.

Contents of Appendix C

Integration Matrices

DISCIPLINE OFFICE : ASTROPHYSICS (EZ)
DATE : DECEMBER 6, 1988

PAYLOAD INTEGRATION CENTERS

Example: X-ray All Sky Monitor

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development					
Design/Fab/Test Hardware	Discipline Office			LANL/GSFC	PI Location
GSE Definition, Design, Development	Discipline Office			LANL/GSFC	About 2 full electronics racks
Analytical Integration of Experiment/Rack/PIA	Discipline Office			LANL/GSFC	
Hardware Integration/Test Requirements Definition	Discipline Office			LANL/GSFC	
Development of Training Hardware	Discipline Office			LANL/GSFC	
Integration and Test Procedure Development	Discipline Office			LANL/GSFC	
Certification Testing	Discipline Office			LANL/GSFC	
Acceptance Testing	Discipline Office			LANL/GSFC	P/L + replacement detector modules
Acceptance Data Package Documentation	Discipline Office			LANL/GSFC	P/L + replacement detector modules
Pack and Ship	Discipline Office			LANL/GSFC	
Preintegration				LANL/GSFC	
Unpack and Receiving Inspection	Discipline Office		√		
Engineering Preps	Discipline Office		√		Small hoist
Post Delivery Verification	Discipline Office		√		
Install in GSE	Discipline Office		√		Functional tests with GSE - 2d purge N2
Servicing	Discipline Office		√		Functional tests with GSE - 2d purge N2
Alignment	Discipline Office		N/A		
Closeout and Turnover	Discipline Office		√		
Experiment to Rack/PIA Integration				LANL/GSFC	
Experiment Integrated Requirements Definition	Flight Systems			LANL/GSFC	
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Rack/PIA and Integration H/W Receiving, Inspection, Checkout	Flight Systems			LANL/GSFC	
Experiment H/W to Rack/PIA Integration	Flight Systems			LANL/GSFC	Interface for telemetry and
Experiment Testing	Discipline Office			LANL/GSFC	power for 12 boxes
Stowage Fit and Function Verification	Flight Systems			LANL/GSFC	
Analytical Integration Models Verification	Flight Systems			LANL/GSFC	
Pack and Ship to Launch Site (if required)	N/A			LANL/GSFC	0-30 deg. F / 0-50% rel.hum.
Preintegration					
Unpack and Receiving Inspection	N/A		√		Same as to Def. & Dev. stage -
Engineering Preps	N/A		√		previous page
Post Delivery Verification	N/A		√		
Install in GSE	N/A		√		
Servicing	N/A		√		
Alignment	N/A		√		Relative placement of boxes
Closeout and Turnover	N/A		√		Relative placement of boxes
					Inert prior to launch
Experiment to Rack/PIA High Fidelity Test					
Experiment Integrated Requirements Definition	Flight Systems				
Experiment Planning and Scheduling	Flight Systems				
Experiment Functional Testing	Flight Systems				
Interface Verification Testing	Flight Systems				Functional data flow
Compatibility Testing	Flight Systems				
End to End Test (if required)	Flight Systems		√		Yes-desired data P/L -

DISCIPLINE OFFICE : ASTROPHYSICS (EZ)
DATE : DECEMBER 6, 1988

PAYLOAD INTEGRATION CENTERS

Example: X-ray All Sky Monitor

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment to Rack/PIA High Fidelity Test (Cont.)					
Closeout and Turnover	Flight Systems				command/telemetry
Rack/PIA to Space Station Integration			√		12 boxes total
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Rack to SS Carrier Installation	Station		√		I/F for telemetry and power
Configure for Rack/PIA to SS I/F Verification	Station		√		
Rack/PIA to SS I/F Verification Testing	Station		√		
Closeout and Turnover	Station		√		
SS to Orbiter Preintegration (CITE)			√		
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Configure for Launch	NSTS/Station		√		
SS to Orbiter I/F Verification Test (Simulation)	NSTS/Station			LANL	Same as before; interface
Non-Hazardous Servicing and Stowage	NSTS/Station		√		simulators - user supplied
Closeout and Turnover	NSTS/Station		√		
SS to Orbiter Integration			√		
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Canister Operations	NSTS/Station		N/A		
PCR Operations	NSTS/Station		N/A		
SS to Orbiter I/F Verification Test	NSTS/Station		√		Yes - as before
Pad Operations	NSTS/Station		√		
Hazardous Servicing	NSTS/Station		N/A		
Late Access	NSTS/Station		√		
Launch Countdown	NSTS/Station		√		
On-Orbit Integration Support			√		
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Rack/PIA from Module/Orbiter Deintegration	NSTS/Station		√		
Rack/PIA to Freedom SS Integration	Station		√		
Rack/PIA to Freedom SS I/F Test	Station		√		Telemetry & power + data
Experiment Testing	Station		N/A		functional flow
Rack/PIA from Freedom SS Deintegration	Station		√		
Rack/PIA to Module/Orbiter Integration	NSTS/Station		√		
Orbiter Deintegration			√		
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems			LANL/GSFC	
Early Access Retrieval	NSTS/Station		N/A		
SS from Orbiter Deintegration	NSTS/Station		N/A		Return probably not required
Deservice/Destowage	NSTS/Station		N/A		
Rack/PIA from SS Deintegration	NSTS/Station		N/A		

DISCIPLINE OFFICE : ASTROPHYSICS (EZ)
DATE : DECEMBER 6, 1988

PAYLOAD INTEGRATION CENTERS

Example: X-ray All Sky Monitor

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Orbiter Deintegration (Cont.)			√		
Experiment from Rack/PIA Deintegration	Flight Systems		N/A		
Post Flight Inspection, Maintenance, Refurbishment	Flight Systems		N/A		
Ship Experiment to Developer	Flight Systems		N/A		

- KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

DISCIPLINE OFFICE : EE (EARTH SCIENCE AND APPLICATIONS)
DATE : 12/6/88

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development					
Design/Fab/Test Hardware	Discipline Office	EOS		GSFC/MSFC	Although MSFC is shown as responsible,
GSE Definition, Design, Development	Discipline Office	EOS		GSFC/MSFC	the payload may be physically located at KSC.
Analytical Integration of Experiment/Rack/PIA	Discipline Office	EOS		MSFC/GSFC	
Hardware Integration/Test Requirements Definition	Discipline Office	EOS		MSFC	The EOS philosophy is that the PI institutions
Development of Training Hardware	Discipline Office	EOS		GSFC	will develop/fabricate/test the experiments.
Integration and Test Procedure Development	Discipline Office	EOS		MSFC/GSFC	They will then "deliver" the experiments
Certification Testing	Discipline Office	EOS		GSFC	to GSFC (physical delivery may be either to
Acceptance Testing	Discipline Office	EOS		GSFC	MSFC or KSC), and GSFC in turn will deliver
Acceptance Data Package Documentation	Discipline Office	EOS		MSFC	the experiment to MSFC. At this point MSFC
Pack and Ship	Discipline Office	EOS		GSFC/PI	becomes the integrator for all EOS attached
					payloads. MSFC will integrate the
Preintegration					experiments
Unpack and Receiving Inspection	Discipline Office			MSFC	
Engineering Preps	Discipline Office			MSFC/GSFC	
Post Delivery Verification	Discipline Office			MSFC	
Install in GSE	Discipline Office			MSFC	
Servicing	Discipline Office			MSFC	
Alignment	Discipline Office			MSFC	
Closeout and Turnover	Discipline Office			MSFC	
Experiment to Rack/PIA Integration					
Experiment Integrated Requirements Definition	Flight Systems	EOS		MSFC	See notes on previous page.
Experiment Planning and Scheduling	Flight Systems	EOS		MSFC/GSFC	
Rack/PIA and Integration H/W Receiving,Inspection,Checkout	Flight Systems	EOS		MSFC	
Experiment H/W to Rack/PIA Integration	Flight Systems	EOS		MSFC	
Experiment Testing	Discipline Office	EOS		GSFC/MSFC	
Stowage Fit and Function Verification	Flight Systems	EOS		MSFC	
Analytical Integration Models Verification	Flight Systems	EOS		MSFC	
Pack and Ship to Launch Site (if required)	N/A	EOS		MSFC	
Preintegration					
Unpack and Receiving Inspection	N/A				
Engineering Preps	N/A				
Post Delivery Verification	N/A				
Install in GSE	N/A				
Servicing	N/A				
Alignment	N/A				
Closeout and Turnover	N/A				
Experiment to Rack/PIA High Fidelity Tests					
Experiment Integrated Requirements Definition	Flight Systems	EOS		MSFC/GSFC	
Experiment Planning and Scheduling	Flight Systems	EOS		MSFC	
Experiment Functional Testing	Flight Systems	EOS		GSFC/MSFC	
Interface Verification Testing	Flight Systems	EOS		GSFC/MSFC	
Compatibility Testing	Flight Systems	EOS		MSFC/GSFC	
End to End Test (if required)	Flight Systems	EOS		MSFC/GSFC	

DISCIPLINE OFFICE : EE (EARTH SCIENCE AND APPLICATIONS)
DATE : 12/6/88

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment to Rack/PIA High Fidelity Tests (Cont.)					
Closeout and Turnover	Flight Systems	EOS		MSFC	
Rack/PIA to Space Station Integration					
Experiment Integrated Requirements Definition	Flight Systems			MSFC	
Experiment Planning and Scheduling	Flight Systems			MSFC	
Rack to SS Carrier Installation	Station			MSFC	
Configure for Rack/PIA to SS I/F Verification	Station			MSFC	
Rack/PIA to SS I/F Verification Testing	Station			MSFC	
Closeout and Turnover	Station			MSFC	
SS to Orbiter Preintegration (CITE)					
Experiment Integrated Requirements Definition	Flight Systems	EOS		MSFC	
Experiment Planning and Scheduling	Flight Systems	EOS		MSFC	
Configure for Launch	NSTS/Station	EOS		MSFC	
SS to Orbiter I/F Verification Test (Simulation)	NSTS/Station	EOS		MSFC	
Non-Hazardous Servicing and Stowage	NSTS/Station	EOS		MSFC	
Closeout and Turnover	NSTS/Station	EOS		MSFC	
SS to Orbiter Integration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Canister Operations	NSTS/Station		√		
PCR Operations	NSTS/Station		√		
SS to Orbiter I/F Verification Test	NSTS/Station		√		
Pad Operations	NSTS/Station		√		
Hazardous Servicing	NSTS/Station		√		
Late Access	NSTS/Station	EOS	√		
Launch Countdown	NSTS/Station	EOS	√		
On-Orbit Integration Support					
Experiment Integrated Requirements Definition	Flight Systems	EOS		MSFC	
Experiment Planning and Scheduling	Flight Systems	EOS		MSFC	
Rack/PIA from Module/Orbiter Deintegration	NSTS/Station	EOS		MSFC	
Rack/PIA to Freedom SS Integration	Station			MSFC	
Rack/PIA to Freedom SS I/F Test	Station			MSFC	
Experiment Testing	Station			MSFC	
Rack/PIA from Freedom SS Deintegration	Station			MSFC	Only after 10 years or failure.
Rack/PIA to Module/Orbiter Integration	NSTS/Station			MSFC	
Orbiter Deintegration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Early Access Retrieval	NSTS/Station	EOS	√		
SS from Orbiter Deintegration	NSTS/Station	EOS	√		
Deservice/Destowage	NSTS/Station	EOS	√		
Rack/PIA from SS Deintegration	NSTS/Station	EOS		MSFC	

DISCIPLINE OFFICE : EE (EARTH SCIENCE AND APPLICATIONS)
DATE : 12/6/88

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Orbiter Deintegration (Cont.)					
Experiment from Rack/PIA Deintegration	Flight Systems	EOS		MSFC	
Post Flight Inspection, Maintenance, Refurbishment	Flight Systems	EOS		GSFC/MSFC	
Ship Experiment to Developer	Flight Systems	EOS		MSFC	

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE: LIFE SCIENCES (EB) ARC
DATE: 11/23/88

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development	Discipline Office	Discipline Office		ARC	
Design/Fab/Test Hardware	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
GSE Definition, Design, Development	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Analytical Integration of Experiment/Rack/PIA	Discipline Office	Discipline Office		ARC	Task req'd as part of design & develop
Hardware Integration/Test Requirements Definition	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Development of Training Hardware	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Integration and Test Procedure Development	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Certification Testing	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Acceptance Testing	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Acceptance Data Package Documentation	Discipline Office	Discipline Office		ARC	Responsibility assigned to ARC by HQ
Pack and Ship		N/A		N/A	N/A
Design/Fab/Test Payload Integration Hardware		Discipline Office		ARC	Responsibility assigned to ARC by HQ
Subsystem Biocompatibility Testing		Discipline Office		ARC	Responsibility assigned to ARC by HQ
Experiment Verification Testing		Discipline Office		ARC	Responsibility assigned to ARC by HQ
Ground Control Exp. Hardware Design, Develop & Test		Discipline Office		ARC	Responsibility assigned to ARC by HQ
Payload Integration & Test Facility Development					
Development & Construction		Discipline Office		ARC	Center responsibility
Test Verification & Training		Discipline Office		ARC	Center responsibility
Preintegration					
Unpack and Receiving Inspection	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Engineering Preps	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Post Delivery Verification	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Install in GSE	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Servicing	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Alignment	Discipline Office	N/A			Experiment to rack integ @ ARC see next page
Closeout and Turnover	Discipline Office	N/A			
Experiment to Rack/PIA Integration					
Experiment Integrated Requirements Definition	Flight Systems	Discipline Office		ARC	Users responsible for deeicated racks
Experiment Planning and Scheduling	Flight Systems	Discipline Office		ARC	Users responsible for deeicated racks
Rack/PIA and Integration H/W Receiving Inspection, Checkout	Flight Systems	Discipline Office		ARC	Aviods deintegration/reintegration
Experiment Testing	Discipline Office	Discipline Office		ARC	Req's live animal & system verification
Stowage Fit and Function Verification	Flight Systems	Discipline Office		ARC	Must be done by user
Analytical Integration Models Verification	Flight Systems	Discipline Office		ARC	Results from ARC tests
Pack and Ship to Launch Site (if required)	N/A	N/A		ARC	
Preintegration					
Unpack and Receiving Inspection	N/A	N/A		N/A	See next page
Engineering Preps	N/A	N/A		N/A	See next page
Post Delivery Verification (If Required)	N/A	N/A		N/A	See next page
Install in GSE	N/A	N/A		N/A	See next page
Servicing	N/A	N/A		N/A	See next page
Alignment	N/A	N/A		N/A	See next page

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE: LIFE SCIENCES (EB) ARC
DATE: 11/23/88

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Closeout and Turnover	N/A	N/A		N/A	See next page
Experiment to Rack/PIA High Fidelity Testing					
Experiment Integrated Requirements Definition	Flight Systems	Discipline Office		ARC	User responsibility
Experiment Planning and Scheduling	Flight Systems	Discipline Office		ARC	User responsibility
Experiment Functional Testing	Flight Systems	Discipline Office		ARC	User responsibility
Interface Verification Testing	Discipline Office	Discipline Office		ARC	Part of hardware buildup
Compatibility Testing	Flight Systems	Discipline Office		ARC	Part of hardware buildup
End to End Test (if required)	Flight Systems	Discipline Office		ARC	Req'd for system verification
Closeout and Turnover	Flight Systems	N/A		N/A	
System Biocompatibility Testing		Discipline Office		ARC	Req's live animals
Experiment Verification Testing		Discipline Office		ARC	Req's live animals
System Cleaning and Servicing		Discipline Office		ARC	Req's live animals
Mass Properties Verification		Discipline Office		ARC	Part of verification req's
Pack and Ship to Integration Site		Discipline Office		ARC	Results from above
Transport and Preintegration		Discipline Office		ARC	Standard user responsibility
Unpack and Receiving Inspection		Discipline Office		ARC	Standard user responsibility
Engineering Preps		Discipline Office		ARC	Standard user responsibility
Post Delivery Verification		Discipline Office		ARC	Standard user responsibility
System Post Transport Functional Test		Discipline Office		ARC	Standard user responsibility
Servicing		Discipline Office		ARC	Standard user responsibility
Closeout and Turnover					
Rack/PIA to Space Station Integration	Flight Systems	Flight Systems	√		
Experiment Integrated Requirements Definition	Flight Systems	Flight Systems	√		
Experiment Planning and Scheduling	Station	Station	√		
Rack to SS Carrier Installation	Station	Station	√		
Configure for Rack/PIA to SS I/F Verification	Station	Station	√		
Rack/PIA to SS I/F Verification Testing	Station	Station	√		
Closeout and Turnover					
SS to Orbiter Preintegration (CITE)					
Experiment Integrated Requirements Definition	Flight Systems	Flight Systems	√		
Experiment Planning and Scheduling	Flight Systems	Flight Systems	√		
Configure for Launch	NSTS/Station	NSTS/Station	√		
SS to Orbiter I/F Verification Test (Simulation)	NSTS/Station	NSTS/Station	√		
Non-Hazardous Servicing and Stowage	NSTS/Station	NSTS/Station	√		
Closeout and Turnover	NSTS/Station	NSTS/Station	√		
SS to Orbiter Integration					
Experiment Integrated Requirements Definition	Flight Systems	Flight Systems	√		
Experiment Planning and Scheduling	Flight Systems	Flight Systems	√		
Canister Operations	Station	Station	√		
PRC Operations	Station	Station	√		

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE: LIFE SCIENCES (EB) ARC
DATE: 11/23/88

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
SS to Orbiter I/F Verification Test	Station	Station	√		
Pad Operations	Station	Station	√		
Hazardous Servicing	Station	Station	√		
Late Access	NSTS/Station	NSTS/Station	√		
Launch Condition	NSTS/Station	NSTS/Station	√		
On-Orbit Integration Support					
Experiment Integrated Requirements Definition	Flight Systems	Flight Systems		Station	
Experiment Planning and Scheduling	Flight Systems	Flight System		Station	
Rack/PIA from Module/Orbiter Definition	NSTS/Station	NSTS/Station		Station	
Rack/PIA to Freedom SS Integration	Station	Station		Station	
Rack/PIA to Freedom SS I/F Test	Station	Station		Station	
Experiment Testing	Station	Station		Station	
Rack/PIA from Freedom SS Deintegration	Station	Station		Station	
Rack/PIA to Module/Orbiter Integration	NSTS/Station	NSTS/Station		Station	
Stowage Integration		Station		Station	
Stowage Deintegration		NSTS/Station		Station	
Specimen Transport/Monitor		NSTS/Station		Station	
Orbiter Deintegration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

OSSA Space Station Payload Integration and Payload Operations Center Requirements Workshop
December 6-9, 1989

AMES RESEARCH CENTER
PAYLOAD INTEGRATION CENTERS MATRIX
RATIONALE

A Payload Integration Center located at Ames and certified to integrate hardware to the flight rack level for the Biological Research Project (BRP) is stipulated in the matrix submitted for the Requirements Workshop. This capability, in conjunction with a Discipline Operations Center as stipulated in the Requirement Workshop Matrix for Payload Operations Centers, is important to the BRP success in implementing the non-human biological research program for Space Station Freedom. The rationale for this approach is introduced here to clarify the need for this capability at Ames to integrate and test flight hardware, and conduct crew training to the level required to verify the mission science objectives will be met.

Ames Research Center has been assigned the lead role in NASA for non-human life sciences research. Within this charter, the center is responsible for implementation of the BRP, a project to conduct non-human biological investigations on-board Space Station Freedom. The BRP will develop and maintain a "permanent" biological research laboratory on-board Freedom; develop, test and integrate the required laboratory support equipment; develop experiment specific equipment; and manage science operations through the life of Freedom.

The implementation plan for BRP is based on Ames overall project experience, and specifically, life sciences experience on Spacelab, COSMOS, and STS secondary payloads.

The major elements of the Freedom life sciences laboratory equipment, called the 1.8 Meter Centrifuge Facility, will be developed under a system level contract with industry. The contractor will be responsible for design, development, and test at the system level without living specimens. Experiment specific hardware and laboratory support equipment will be developed by science investigators or Ames.

Subsequent to completion of centrifuge facility testing by the system contractor, the hardware will be moved to the Space Station Life Sciences Space Flight Facility at Ames and integrated with experiment specific and laboratory support equipment for mandatory testing at the system level with living specimens. These tests require that the BRP hardware be integrated to the rack level, as it has been for Spacelab missions. However, contrary to Spacelab experience, the BRP plan calls for initial integration and test directly with flight racks, eliminating the need for subsequent deintegration and reintegration into flight racks at KSC. Our experience has shown the Spacelab approach has been extremely time consuming, costly, and a burden on off-site facilities, schedules, and resources.

Justification for the development of new ground capability at Ames, i.e., the Life Sciences Space Flight Facility, is based on the on-going need for testing of new experiment equipment and evolutionary 1.8 Meter Centrifuge Facility equipment, crew training with live specimens in conjunction with Facility equipment, and the conduct of ground control experiments throughout the life of Freedom. These requirements exist regardless of any decision relative to the Freedom program providing flight racks for use at Ames. Since there is a firm long-term requirement for this capability, it is the BRP position that the most efficient approach is to work directly with flight racks at Ames verifying form, fit, and function at the rack level prior to shipment.

The matrix prepared by the BRP office for the workshop reflects this approach. Below is an explanation of the matrix by major section with backup rationale to substantiate the BRP approach.

1. Experiment Payload Definition and Development - page 1 of matrix

The items listed down through "Pack and Ship" have been maintained as they were in the Spacelab baseline under Discipline Responsibility. Except for the third item, Analytical Integration of Experiment/Rack/PIA, all of these activities are clearly the responsibility of the development center and must be maintained at the center. Our experience in previous programs shows the analytical integration function at the rack level is normally done by the responsible discipline office for payloads where entire racks are dedicated to a single user. Further analyses of this type will be required as part of the design process. Therefore, the function has been designated here as an Ames responsibility. Products of these analyses are then used as inputs to higher level integration analysis (i.e., integrated rack to Freedom interface).

2. Payload Integration & Test Facility Development

A new ground facility is required at Ames to support BRP. The planned Life Sciences Space Flight Facility will provide a 42,000 square foot addition to an existing building (N244). This addition, along with use for 35,000 square feet of existing space in N244 will provide the capability to develop and operate flight and ground systems needed to perform life sciences investigations assigned to BRP. The facility will provide and support:

- Biocompatibility and Experiment Verification testing
- Development and testing of ancillary laboratory support equipment
- Development and testing of experiment unique equipment
- Simulation facilities for flight crew training
- Facilities for synchronous ground control experiments
- Simulated and flight operations facilities
- Development and testing of evolutionary hardware for upgrading and expanding the capability of the 1.8 Meter Centrifuge and other equipment.
- Specimen holding and biological pre- and post- flight laboratory areas

Prior to initiation of activities involving flight hardware, a facility test and verification program will be conducted. This program will certify environmental control systems, power systems, cranes, etc. for use with flight hardware. During this process, facility integration, test, and operations personnel will be trained and certified.

3. Preintegration - page 2 of matrix

This section has been marked as Not Applicable since, in the Ames scenario, shipment does not occur until after Experiment to Rack Integration.

4. Experiment to Rack/PIA High Fidelity Testing - page 3 of matrix

The first three items in this section represent user responsibilities for racks dedicated to a single discipline. Interface Verification, Compatibility and Verification tests must be accomplished during the rack integration in conjunction with the subsystem and system level test and verification process. Biocompatibility and Experiment Verification tests require the use of live specimens and, therefore, must be conducted at Ames. Post-test cleaning and servicing are required prior to shipping. Ames experience has been that mission management requires mass properties measurements as part of the verification process. Therefore, this task has been required prior to shipment. If, for the Freedom program, it is not required prior to shipment, this task could be moved to KSC.

5. Transport and Preintegration - page 3 of matrix

These are activities which are normally user responsibilities prior to turning the hardware over to KSC for their integration activities.

6. **Rack/PIA to Space Station Integration** - page 3 of matrix

   Agree with baseline approach, i.e., these are KSC activities.

7. **SS or Orbiter Preintegration (CITE)** - page 4 of matrix

   Agree with baseline approach, i.e., these are KSC activities.

8. **SS to Orbiter Integration** - page 4 of matrix

   Agree with baseline approach, i.e., these are KSC activities.

9. **On-Orbit Integration Support** - page 5 of matrix

   These activities have been recommended to be Freedom responsibilities but will require major inputs and realtime interactions with Ames during implementation.

10. **Orbiter Deintegration** - page 5 of matrix

    Agree with baseline approach (i.e., these are KSC activities) for all tasks up through Rack/PIA from SS Deintegration.

    The remaining activities should be done at Ames to be consistent Ames responsibility for rack level integration. A critical issue is the required accountability for reflight certification which can best be accomplished by the hardware integration team. In addition, this will provide an opportunity for post mission equipment performance analysis during the deintegration process.

DISCIPLINE OFFICE : JSC LIFE SCIENCES (EB)
DATE : 12/6/88 (11:45 p.m.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	PHASE	AREA	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development							
[Science Definition and Development, and							
Experiment Hardware/Software Definition, Design,							
Development/Fabrication, and Testing]							
Define Experiment Requirements	V	Hardware	Discipline Office	Discipline Office		PI/EDC	Discipline hardware and science
Experiment Hardware Definition/Design/Fabricate/Test	V	Hardware	Discipline Office	Discipline Office		EDC	definition, design, development
GSE Definition/Design/Development	V	Hardware	Discipline Office	Discipline Office		EDC	at the user's facility/Experiment
SS-provided Equipment Definition	V	Hardware	Discipline Office	Discipline Office		EDC/JSC	Development Center (EDC)
Analytical Integration of Experiment Hardware & Software	V	Hardware	Discipline Office	Discipline Office		JSC	
Hardware Integration Test and Verification Req'ts Definition	V	Hardware	Discipline Office	Discipline Office		EDC/JSC	
Development of Training Hardware	V	Hardware	Discipline Office	Discipline Office		EDC	
Integration, Test & Verification Procedure Development	V	Hardware	Discipline Office	Discipline Office		EDC/JSC	
Safety, Reliability, Maintainability, and Quality Assurance	V	Hardware					
Requirements Implementation	V	Hardware	Discipline Office	Discipline Office		EDC/JSC	
Packaging, Handling, Stowage, and Transportation Req'ts Def	V	Hardware	Discipline Office	Discipline Office		EDC	
Logistics Requirements Definition	V	Hardware	N/A	Discipline Office		EDC/JSC	
Certification/Acceptance Testing	V	Hardware	Discipline Office	Discipline Office		EDC	
Acceptance Data Package Documentation	V	Hardware	Discipline Office	Discipline Office		EDC	
Pack and Ship to JSC (if required)	V	Hardware	Discipline Office	Discipline Office		EDC	
Define Experiment Control Software	V	Data	Discipline Office	Discipline Office		EDC	
Design/Test Experiment Software	V	Data	Discipline Office	Discipline Office		EDC/JSC	
Definition/Development of Verification Software	V	Data	Discipline Office	Discipline Office		EDC/JSC	
Definition/Development/Test Network Interfaces	V	Data	Discipline Office	Discipline Office		JSC/DOC	
Develop Flight Support Ground Software	V	Data	Discipline Office	Discipline Office		JSC/DOC	
Preintegration							
Unpack and Receiving Inspection	V-IV/III	Logistics	Discipline Office	Discipline Office		JSC	Required
Engineering Preparations	V-IV/III	Logistics	Discipline Office	Discipline Office		JSC	
Post-Delivery Verification	V-IV/III	Logistics	Discipline Office	Discipline Office		JSC	
Install in GSE	V-IV/III	Logistics	Discipline Office	Discipline Office		JSC	
Servicing	V-IV/III	Logistics	Discipline Office	Discipline Office		JSC	
Rack/PIA Staging/Exp't Hdwr/Stwr Integ.							
Integrated Experiments Hardware/Software Req'ts Def.	IV	Hardware	Flight Systems	Discipline Office		EDC/JSC	JSC responsibility to ensure entire
Experiment Planning and Scheduling	IV	Hardware	Flight Systems	Discipline Office		JSC	subsystems prior to shipment to launch site;
Rack/PIA and Integration H/W Receiving,Inspection,Checkout	IV	Hardware	Flight Systems	Discipline Office		JSC	expertise exists at JSC; prevents major
Rack Staging (if required)	IV	Hardware	Flight Systems	Discipline Office		JSC	problems at launch site; precursor to science
Experiment Hardware-to-Rack Integration	IV	Hardware	Flight Systems	Discipline Office		JSC	verification test (JSC responsibility)
Experiment Hardware-to-Rack Interface Testing	IV	Hardware	Flight Systems	Discipline Office		JSC	
Form, Fit, Function Test	IV	Hardware	Flight Systems	Discipline Office		JSC	
Test Experiment Software	IV	Data	Flight Systems	Discipline Office		JSC	
Test Ground Processing Software	IV	Data	Flight Systems	Discipline Office		JSC	
Test Data Archival	IV	Data	Flight Systems	Discipline Office		JSC	
Test Remote Interfaces	IV	Data	Flight Systems	Discipline Office		JSC	
Test Command and Control Software	IV	Data	Flight Systems	Discipline Office		JSC	

DISCIPLINE OFFICE : JSC LIFE SCIENCES (EB)
DATE : 12/6/88 (11:45 p.m.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	PHASE	AREA	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Exp't Hardware/Software to Rack Verif. Test							
Integrated Experiments Hardware/Software Requirements Det	III	Hardware	Flight Systems	Discipline Office		EDC/JSC	Without interfacing subsystems prior to
Experiment Planning and Scheduling	III	Hardware	Flight Systems	Discipline Office		JSC	shipment to launch site; with interfacing
Integrated Racks to SS Systems Simulators Testing	III	Hardware	Flight Systems	Discipline Office		JSC	subsystems prior to shipment to launch site;
Systems Interface Testing/Verification	III	Hardware	Flight Systems	Discipline Office		JSC	expertise exists at JSC; prevents major
Integrated Experiment Hardware/Software Functional Testing	III	Hardware	Flight Systems	Discipline Office		JSC	problems at launch site; precursor to science
Systems Compatibility Testing	III	Hardware	Flight Systems	Discipline Office		JSC	verification test (JSC responsibility)
Stowage Verification	III	Hardware	Flight Systems	Discipline Office		JSC	
Analytical Integration Models Verification	III	Hardware	Flight Systems	Discipline Office		JSC	
Systems End-to-End Test	III	Hardware	Flight Systems	Discipline Office		JSC	
JSC Discipline Science Verification	III	Hardware	Discipline Office	Discipline Office		JSC	
JSC Discipline Crew Training	III	Hardware	Discipline Office	Discipline Office		JSC	
Verify Data Packs Complete for Launch Site	III	Hardware	Flight Systems	Discipline Office		JSC	
Ship Integrated Racks/Stowage/GSE to Launch Site	III	Hardware	N/A	Discipline Office		JSC	
Ship Training Hardware to PTIF	III	Hardware	N/A	Discipline Office		JSC	
Verify Experiment Software	III	Data	Flight Systems	Discipline Office		JSC	
Verify Ground Processing Software	III	Data	Flight Systems	Discipline Office		JSC	
Verify Data Archival	III	Data	Flight Systems	Discipline Office		JSC	
Verify Remote Interfaces	III	Data	Flight Systems	Discipline Office		JSC	
Verify Command and Control Software	III	Data	Flight Systems	Discipline Office		JSC	
Preintegration							
Unpack and Receiving Inspection	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Engineering Preparations	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Post-Delivery Verification	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Install in GSE	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Experiment/Rack Functional Testing	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Servicing	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Turnover	IV/III-II	Logistics	Flight Sys./Disc.	Discipline Office	√	N/A	Supported by JSC personnel
Rack/PIA/Payload-to-Space Station Integration							
Experiment Integrated Requirements Definition	II	Hardware	Flight Sys./Disc.	SS/Discipline	√	N/A	Supported by JSC personnel
Experiment Planning and Scheduling	II	Hardware	Flight Sys./Disc.	SS/Discipline	√	N/A	Supported by JSC personnel
Rack-to-SS Module/Carrier Installation	II	Hardware	Flight Sys./Disc.	SS/Discipline	√	N/A	Supported by JSC personnel
Configure for Rack/PIA/Payload-to-SS I/F Verification	II	Hardware	Flight Sys./Disc.	SS/Discipline	√	N/A	Supported by JSC personnel
Rack/PIA/Payload to SS I/F Verification Testing	II	Hardware	Flight Sys./Disc.	SS/Discipline	√	N/A	Supported by JSC personnel
Module/Carrier Closeout and Transfer	II	Hardware	Flight Sys./Disc.	SS	√	N/A	
Data End-to-End Verification Test	II	Data	Flight Sys./Disc.	SS/Discipline	√	JSC DOC/UOF	Final verification required to ensure operation
Test Data Archival	II	Data	Flight Sys./Disc.	SS/Discipline	√	JSC DOC/UOF	of systems
SS-to-Orbiter Preintegration (CITE)							
Configure for Launch	II	Hardware	NSTS	NSTS/Station	√	N/A	
SS-to-Orbiter I/F Verification Test (Simulation)	II	Hardware	N/A	NSTS/Station	√	N/A	
Non-Hazardous Servicing and Stowage	II	Hardware	NSTS	NSTS/Station	√	N/A	
Closeout and Turnover	II	Hardware	NSTS	NSTS/Station	√	N/A	

DISCIPLINE OFFICE : JSC LIFE SCIENCES (EB)
DATE : 12/6/88 (11:45 p.m.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	PHASE	AREA	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
SS-to-Orbiter Integration							
[SS Module/Carrier-to-Orbiter Integration]							
Experiment Integrated Requirements Definition	I	Hardware	Flight Systems	Discipline/SS	√	N/A	
Experiment Planning and Scheduling	I	Hardware	Flight Systems	Discipline/SS	√	N/A	
Canister Operations	I	Hardware	NSTS	NSTS/Station	√	N/A	
PCR Operations	I	Hardware	NSTS	NSTS/Station	√	N/A	
SS-to-Orbiter I/F Verification Test	I	Hardware	NSTS	NSTS	√	N/A	
Pad Operations	I	Hardware	NSTS	NSTS	√	N/A	
Hazardous Servicing	I	Hardware	NSTS	NSTS	√	N/A	
Samples/Hardware Preparation for Late Access Loading	I	Hardware	Discipline	Discipline	√	N/A	Supported by JSC personnel
Late Access/Stowage Support	I	Hardware	NSTS/Discipline	SS/NSTS	√	N/A	
Launch Countdown	I	Hardware	NSTS/SL	NSTS	√	N/A	
Monitoring of Critical Hardware Status (on Launch Pad)	I	Data	Discipline/SL	Disc./SS/NSTS		JSC DOC	PI may require data on temperature or other
							critical parameters
On-Orbit Integration Support							
Payload from Module/Orbiter Deintegration	0	Hardware	N/A	Discipline/SS	√	SS/JSC	Engineering expertise will exist on hardware
Payload-to-SS Freedom Integration	0	Hardware	N/A	Discipline/SS	√	SS/JSC	which has been integrated at JSC
Payload-to-SS Freedom SS I/F Test	0	Hardware	N/A	Discipline/SS	√	SS/JSC	
Experiment-level Verification/Testing	0	Hardware	N/A	Discipline/SS	√	SS/JSC	
Payload-from-SS Freedom SS Deintegration	0	Hardware	N/A	Discipline/SS	√	SS/JSC	
Payload-to-Module/Orbiter Integration	0	Hardware	N/A	Disc./NSTS/SS	√	SS/JSC	
Experiment Trouble-Shooting/Maintenance/Repair	0	Hardware	N/A	Discipline/SS	√	SS/JSC	
Orbiter Deintegration							
[Orbiter Deintegration and Post-flight Operations]							
JSC Discipline Integrated Requirements Definition	Post Flight V'	Hardware	Flight Systems	Discipline/SS		JSC DOC	Understanding of unique discipline
JSC Discipline Planning and Scheduling	Post Flight V'	Hardware	Flight Systems	Discipline/SS		JSC DOC	requirements exists at JSC
Early Access Retrieval of Time-Sensitive Samples/Products	Post Flight V'	Hardware	NSTS/Discipline	NSTS/Discipline	√	Landing Site	:
SS Module/Carrier Deintegration from Orbiter Deintegration	Post Flight V'	Hardware	NSTS	SS/NSTS	√		
Rack/Payload from SS Module/Carrier Deintegration	Post Flight V'	Hardware	NSTS	SS/NSTS/Disc.			
Experiment from Rack/PIA Deintegration	Post Flight V'	Hardware	Flight Systems	Discipline Office		JSC	Reduced turn-around time for flight racks
Preparation/Shipment of Experiment Hardware/Samples	Post Flight V'	Hardware	Flight Systems	Discipline Office		JSC	which will be reintegrated by JSC
Rack Post-flight Inspection, Maintenance, Refurbishment	Post Flight V'	Hardware	Flight Systems	Discipline Office		JSC	JSC responsibility to ensure

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

DISCIPLINE OFFICE: MSAD
DATE: DECEMBER 7, 1988 (1:05 a.m.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION: Development Center/Site: LeRC	JPL	JSC	MSFC	SS Freedom MSFC/WP01
Experiment Payload Definition and Dev.								
Design/Fabricate/Test Hardware	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
GSE Definition/Design/Development	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Analytical Integration of Experimentor Rack	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Development of Training Hardware	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Integration and Test Procedures Development	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Certification Testing	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Acceptance Testing	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Acceptance Data Package Documentation	Discipline Office	MSAD		Yes	Yes	TBD	Yes	
Pack and Ship	Discipline Office	N/A		N/A	N/A	N/A	Yes	
Preintegration (1)								
Unpack and Receiving Inspection	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Engineering Preparations	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Post Delivery Verification	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Install in GSE	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Servicing	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Alignment	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Closeout and Turnover	Discipline Office	MSAD	√	N/A	N/A	TBD	N/A	Available?
Experiment to Rack Integration								
Experiment Integrated Requirements Definition	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Experiment Planning and Scheduling	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Rack and Integration H/W Rcvng/Inspec./Checkout	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Experiment Hardware to Rack Integration	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Experiment Testing	Discipline Office	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Stowage Fit and Function Verification	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Analytical Integration Models Verification	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Pack and Ship to Launch Site	Flight Systems	MSAD Dev. Site	√	Yes, see pg. 1	Yes, see pg. 2	TBD, see pg. 3	Yes, see pg. 4	Available?
Preintegration (2)								
Unpack and Receiving Inspection	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Engineering Preparations	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Post Delivery Verification	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Install in GSE	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Servicing	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Alignment	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Closeout and Turnover	N/A	MSAD		@KSC	@KSC	@KSC	@ KSC or ->	See page 5
Experiment to Rack High Fidelity Testing								
Experiment Integration Requirement Definition	Flight Systems	Flight Systems	√					Yes, see pg. 5
Experiment Planning in Scheduling	Flight Systems	Flight Systems	√					Yes, see pg. 5
Experiment Functional Testing	Flight Systems	Flight Systems	√					Yes, see pg. 5
Interface Verification Testing	Flight Systems	Flight Systems	√					Yes, see pg. 5
Compatibility Testing	Flight Systems	Flight Systems	√					Yes, see pg. 5
End to End Test	Flight Systems	Flight Systems	√					Yes, see pg. 5
Closeout and Turnover	Flight Systems	Flight Systems	√					Yes, see pg. 5

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PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION Development Center/Site LeRC	JPL	JSC	MSFC	SS Freedom MSFC/WP01
Payload to Space Station Element Integration								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Payload Planning and Scheduling	Flight Systems	Flight Systems	√					
Payload to SS Element Carrier Integration	Station	Station	√					
Configure for Payload to SS Interface Verification	Station	Station	√					
Payload to SS Interface Verification	Station	Station	√					
Closeout and Turnover	Station	Station	√					
SS to Orbiter Preintegration (CITE)								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Payload Planning and Scheduling	Flight Systems	Flight Systems	√					
Configure for Launch	NSTS/Station	NSTS/Station	√					
SS Element to Orbiter I/F Verification Testing	NSTS/Station	NSTS/Station	√					
Non-Hazardous Servicing and Stowage	NSTS/Station	NSTS/Station	√					
Closeout and Turnover	NSTS/Station	NSTS/Station	√					
SS Element to Orbiter Integration								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Payload Planning and Scheduling	Flight Systems	Flight Systems	√					
Cannister Operations	NSTS/Station	NSTS/Station	√					
PCR Operation	NSTS/Station	NSTS/Station	√					
SS to Orbiter I/F Verification Test	NSTS/Station	NSTS/Station	√					
Pad Operations	NSTS/Station	NSTS/Station	√					
Hazardous Servicing	NSTS/Station	NSTS/Station	√					
Late Access	NSTS/Station	NSTS/Station	√					
Launch Countdown	NSTS/Station	NSTS/Station	√					
On-Orbit Integration Support								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Experiment Planning and Scheduling	Flight Systems	Flight Systems	√					
Payload Deintegration from Logistics Element	NSTS/Station	NSTS/Station	√					
Payload Integration to SS Freedom Lab	Station	Station	√					
Payload to SS Freedom Interface Testing	Station	Station	√					
Payload/Experiment Testing	Station	Station/MSAD	√					
On-Orbit Deintegration Support								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Payload Planning and Scheduling	Flight Systems	Flight Systems	√					
Payload Deintegration from SS Freedom	Station	Station	√					
Payload Integration to Logistics Element	NSTS/Station	NSTS/Station	√					
Orbiter Deintegration								
Payload Integrated Requirements Definition	Flight Systems	Flight Systems	√					
Payload Planning and Scheduling	Flight Systems	Flight Systems	√					
Early Access Retrieval	NSTS/Station	NSTS/Station	√					
SS Element from Orbiter Deintegration	NSTS/Station	NSTS/Station	√					
Deservice/Destowage	NSTS/Station	NSTS/Station	√					

DISCIPLINE OFFICE: MSAD
DATE: DECEMBER 7, 1988 (1:05 a.m.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION				
				Development Center/Site				SS Freedom
				LeRC	JPL	JSC	MSFC	MSFC/WP01
Orbiter Deintegration (Cont.)								
Payload from SS Element Deintegration	NSTS/Station	NSTS/Station	√					
Experiment from Rack Deintegration	Flight Systems	MSAD	√	Yes	Yes	Yes	TBD	Yes
Post Flight Inspection/Maintenance/Refurbishment	Flight Systems	MSAD/Flight Sys	√	Yes	Yes	Yes	TBD	Yes
Ship Experiment to Developer	Flight Systems	Flight Systems	√					

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

MSAD Payload Integration Capability Justification
Jet Propulsion Laboratory

General

MSAD proposes to have JPL (or its contractor field site) certified to perform limited payload physical integration activities. These activities include flight rack staging, experiment/facility to rack integration, experiment module to logistics storage container integration, experiment/rack testing, and deintegration. High fidelity interface simulation or testing will be performed at the launch site.

Experiment Payload Definition and Development

MSAD has designated JPL as the development center for microgravity science containerless processing flight hardware. In the future, JPL will develop a single Space Station mutli-user "Facility-Class" payload known as the Modular Containerless Processing Facility. The payload is projected to be as large as two space station racks. In addition, JPL will develop experiment modules to be used on-orbit with the Facility.

Preintegration (1):

This section is not applicable, since payload build-up and rack integration will take place at the development site. JPL/MSAD will assume responsibility for the appropriate "site-to-site" shipment within JPL, if any.

Experiment to Rack Integration

Justification for the delegation of integration authority, and holding of flight racks, includes:

(1) Reduction in overall integration time of up to five months, due to lack of duplication of effort outside the launch site.
(2) Minimization of hardware handling, to reduce risk of damage and facilitate on-time delivery to the launch site;
(3) Existing physical clean room and assembly facilities have been identified, but require certification.
(4) Early problem identification due to the ability to perform payload fit and function checks in a "near" flight configuration;
(5) Should integration anomalies occur, the developer will have the engineering expertise and materials/equipment needed on hand at the integration location.
(6) Lower MSAD costs due to early problem resolution at the development center;
(7) Manpower and travel expenses for nominal launch site physical integration are minimized;

MSAD/JPL will assume responsibility to ship the integrated experiment/rack to the OSSA Integration Center at the launch site for high fidelity interface testing.

Experiment to Rack High Fidelity Testing. Agree with OSSA "strawman" scenario.

Payload/Rack to Station Element Integration. Agree with OSSA "strawman" scenario.

SS to Orbiter Preintegration (CITE). Agree with OSSA "strawman" scenario.

SS to Orbiter Integration. Agree with OSSA "strawman" scenario.

On-Orbit Integration Support. Agree with OSSA "strawman" scenario.

On-Orbit Deintegration Support. Agree with OSSA "strawman" scenario.

Orbiter Deintegration

The OSSA Integration Center should ship the still integrated Payload/Rack back to JPL for Facility hardware deintegration. Racks (if not assigned to another JPL facility/payload) would be delivered to the Integration Center or SSPF after de-staging. Logistics Containers would be maintained at JPL for the next experiment module to be shipped to SS Freedom.

MSAD Payload Integration Capability Justification

Johnson Space Center

General

MSAD proposes to have JSC certified to perform limited payload physical integration activities. These activities include rack staging, experiment/facility to rack integration, experiment module to logistics storage container integration, experiment/rack testing, and deintegration. High fidelity interface simulation or testing will be performed at the launch site.

Experiment Payload Definition and Development

MSAD has designated JSC as the development center for microgravity science biotechnology flight hardware. In the future, JSC will develop a single Space Station mutli-user "Facility-Class" payload known as the Biotechnology Facility. The payload is projected to be at least as large as a space station rack. In addition, JSC will develop the majority of the experiment modules to be used on-orbit with the Facility over its many year life.

Preintegration (1):

This section is not applicable, since payload build-up and rack integration will take place at the development site. JSC/MSAD will assume responsibility for the appropriate "site-to-site" shipment within LeRC, if any.

Experiment to Rack Integration

Justification for the delegation of integration authority, and holding of flight racks, includes:

(1) Minimization of hardware handling, to reduce risk of damage and facilitate on-time delivery to the launch site;
(2) Early problem identification due to the ability to perform payload fit and function checks in a "near" flight configuration;
(3) Should integration anomalies occur, the developer will have the engineering expertise and materials/equipment needed on hand at the integration location.
(4) Lower MSAD costs due to early problem resolution at the development center;
(5) Manpower and travel expenses for nominal launch site physical integration are minimized;

Preintegration (2)

MSAD/JSC will assume responsibility to ship the integrated experiment/rack to the OSSA Integration Center at the launch site for high fidelity interface testing.

Experiment to Rack High Fidelity Testing. Agree with OSSA "strawman" scenario.

Payload/Rack to Station Element Integration. Agree with OSSA "strawman" scenario.

SS to Orbiter Preintegration (CITE). Agree with OSSA "strawman" scenario.

SS to Orbiter Integration. Agree with OSSA "strawman" scenario.

On-Orbit Integration Support. Agree with OSSA "strawman" scenario.

On-Orbit Deintegration Support. Agree with OSSA "strawman" scenario.

Orbiter Deintegration

The OSSA Integration Center should ship the still integrated Payload/Rack back to JSC for experiment deintegration. Racks (if not assigned to another JSC payload) would be delivered to the Integration Center or SSPF after de-staging. Logistics Containers would be maintained at JSC for the next experiment module to be shipped to SS Freedom.

MSAD Payload Integration Capability Justification
Lewis Research Center

General

MSAD proposes to have the LeRC certified to perform limited payload physical integration activities. These activities include rack staging, experiment/facility to rack integration, experiment module to logistics storage container integration, experiment/rack testing, and deintegration. High fidelity interface simulation or testing will be performed at the launch site.

Experiment Payload Definition and Development

MSAD has designated LeRC as the lead center for microgravity science combustion and fluid physics/dynamics hardware development. LeRC is currently responsible for the majority of MSAD combustion hardware and most of the fluid physics/dynamics flight hardware. In the future, LeRC will develop two Space Station mutli-user "Facility-Class" payloads, one for each of the above disciplines. Each payload is projected to be at least as large as two space station racks. In addition, LeRC will develop the majority of the experiment modules to be used on-orbit with the two Facilities.

Preintegration (1):

This section is not applicable, since payload build-up and rack integration will take place at the development site. LeRC/MSAD will assume responsibility for the appropriate "site-to-site" shipment within LeRC, if any.

Experiment to Rack Integration

Justification for the delegation of integration authority, and holding of flight racks, includes:

(1) Minimization of hardware handling, to reduce risk of damage and facilitate on-time delivery to the launch site;
(2) Early problem identification due to the ability to perform payload fit and function checks in a "near" flight configuration;
(3) LeRC payload will fly late in the Assy Sequence (flt 20), so Integration capability certification can take advantage of lessons learned at other, earlier development centers.
(4) Should integration anomalies occur, the developer will have the engineering expertise and materials/equipment needed on hand at the integration location.
(5) Lower MSAD costs due to early problem resolution at the development center;
(6) Manpower and travel expenses for nominal launch site physical integration are minimized.

Preintegration (2)

MSAD/LeRC will assume responsibility to ship the integrated experiment/rack to the OSSA Integration Center at the launch site for high fidelity interface testing.

Experiment to Rack High Fidelity Testing. Agree with OSSA "strawman" scenario.

Payload/Rack to Station Element Integration. Agree with OSSA "strawman" scenario.

SS to Orbiter Preintegration (CITE). Agree with OSSA "strawman" scenario.

SS to Orbiter Integration. Agree with OSSA "strawman" scenario.

On-Orbit Integration Support. Agree with OSSA "strawman" scenario.

On-Orbit Deintegration Support. Agree with OSSA "strawman" scenario.

Orbiter Deintegration

The OSSA Integration Center should ship the still integrated Payload/Rack back to LeRC for experiment deintegration. Racks (if not assigned to another LeRC payload) would be delivered to the Integration Center or SSPF after de-staging. Logistics Containers would be maintained at LeRC for the next experiment module to be shipped to SS Freedom.

MSAD Payload Integration Capability Justification

Marshall Space Flight Center (Development Center)

General

MSAD proposes to have MSFC certified to perform limited payload physical integration activities. These activities include flight rack staging, experiment/facility to rack integration, experiment module to logistics storage container integration, experiment/rack testing, and deintegration. High fidelity interface simulation or testing will be performed at the launch site or at the MSFC WP01 US Laboratory Module facilities (see justification for WP01 area).

Experiment Payload Definition and Development

MSAD has designated MSFC as the prime development center for microgravity science crystal growth and furnace flight hardware. In the future, MSFC will develop a two Space Station mutli-user "Facility-Class" payloads, known as the Advanced Protein Crystal Growth Facility and the Space Station Furnace Facility. Each Facility payload is projected to be at least as large as two Space Station racks. In addition, MSFC will develop most of the experiment modules to be used on-orbit with these Facilities, as well as experiment modules for the JPL Modular Containerless Processing Facility. MSAD is planning the two MSFC developed Facilities for launch as early as USL delivery to Space Station on assembly flight #4.

Preintegration (1):

It is assummed that payload pe-integration will take place at the MSFC development site, since Experiment (Facility)/Rack integration is projected for this area.

Experiment to Rack Integration

Justification for the delegation of integration authority, and holding of flight racks, includes:

(1) Identical capability for Space Station Systems Hardware will be available at the WP01 area; will be available for limited number of payloads (see justification for WP01 area)
(2) Reduction in overall integration time of up to five months, due to lack of duplication of effort at the launch site;
(3) Minimization of hardware handling, to reduce risk of damage and facilitate on-time delivery to the launch site;
(4) Early problem identification due to the ability to perform payload fit and function checks in a "near" flight configuration;
(5) Should integration anomalies occur, the developer will have the engineering expertise and materials/equipment needed on hand at the integration location.
(6) Lower MSAD costs due to early problem resolution at the development center;
(7) Manpower and travel expenses for nominal launch site physical integration are minimized.

Preintegration (2)

MSAD/MSFC will assume responsibility to ship the integrated experiment/rack to the OSSA Integration Center at the launch site for high fidelity interface testing. If such testing has been accomplished at the MSFC WP01 area, the integrated experiment/rack will be shipped to the KSC SSPF for launch package integration in the appropriate pressurized module.

Experiment to Rack High Fidelity Testing. Agree with OSSA "strawman" scenario. However, see the justification for WP01 area.

Payload/Rack to Station Element Integration. Agree with OSSA "strawman" scenario.

SS to Orbiter Preintegration (CITE). Agree with OSSA "strawman" scenario.

SS to Orbiter Integration. Agree with OSSA "strawman" scenario.

On-Orbit Integration Support. Agree with OSSA "strawman" scenario.

On-Orbit Deintegration Support. Agree with OSSA "strawman" scenario.

Orbiter Deintegration

The OSSA Integration Center should ship the still integrated Payload/Rack back to MSFC for experiment deintegration. Racks (if not assigned to another MSFC facility/payload) would be delivered to the Integration Center or SSPF after de-staging. Logistics Containers would be maintained at MSFC for the next experiment module to be shipped to SS Freedom.

MSAD Payload Integration Capability Justification
Marshall Space Flight Center (WP01 Area)

General

MSAD proposes to have OSSA utilize the SSP WP01 facilities at MSFC to perform high fidelity interface verification and testing for the intial complement of MSAD payloads which are shipped to orbit with the USL.

Experiment Payload Definition and Development

Not Applicable.

Preintegration (1):

Not Applicable.

Experiment to Rack Integration

Not Applicable.

Preintegration (2)

MSAD/MSFC will assume responsibility to ship the integrated experiment/rack to the MSFC WP01 Integration Area for high fidelity interface testing.

Experiment to Rack High Fidelity Testing

High Fidelity interface testing, commonality testing and End-to-End testing will be performed at the USL staging area, and not duplicated at the lauch site. After such testing has been accomplished at the MSFC WP01 area, the integrated experiment/rack will be shipped to the KSC SSPF for launch package integration in the appropriate pressurized module.

Payload/Rack to Station Element Integration

Not Applicable.

SS to Orbiter Preintegration (CITE)

Not Applicable.

SS to Orbiter Integration

Not Applicable.

On-Orbit Integration Support

Not Applicable.

On-Orbit Deintegration Support

Not Applicable.

Orbiter Deintegration

Not Applicable.

DISCIPLINE OFFICE : SOLAR SYSTEM EXPLORATION (EL)
DATE : 12/6/88 (10:20 P.M.)

PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development					
Design/Fab/Test Hardware	Discipline Office			CONTRACTOR	
GSE Definition, Design, Development	Discipline Office			CONTRACTOR	
Analytical Integration of Experiment/Rack/PIA	Discipline Office			CONTRACTOR	
Hardware Integration/Test Requirements Definition	Discipline Office			CONTRACTOR	
Development of Training Hardware	Discipline Office			CONTRACTOR	
Integration and Test Procedure Development	Discipline Office			CONTRACTOR	
Certification Testing	Discipline Office			CONTRACTOR	
Acceptance Testing	Discipline Office			CONTRACTOR	
Acceptance Data Package Documentation	Discipline Office			CONTRACTOR	
Pack and Ship	Discipline Office			CONTRACTOR	
Preintegration					
Unpack and Receiving Inspection	Discipline Office			CONTRACTOR	
Engineering Preps	Discipline Office			CONTRACTOR	
Post Delivery Verification	Discipline Office			CONTRACTOR	
Install in GSE	Discipline Office			CONTRACTOR	
Servicing	Discipline Office			CONTRACTOR	
Alignment	Discipline Office			CONTRACTOR	
Closeout and Turnover	Discipline Office			CONTRACTOR	
				CONTRACTOR	*N/A to CDCF
Experiment to Rack/PIA Integration					
Experiment Integrated Requirements Definition		Discipline Office		CONTRACTOR	FOR CDCF
Experiment Planning and Scheduling		Discipline Office		CONTRACTOR	FOR CDCF
Rack/PIA and Integration H/W Receiving,Inspec.,Checkout	Flight Systems	Discipline Office		CONTRACTOR	FOR CDCF
Experiment H/W to Rack/PIA Integration	Flight Systems	Discipline Office		CONTRACTOR	FOR CDCF
Experiment Testing	Discipline Office	Discipline Office		CONTRACTOR	FOR CDCF
Stowage Fit and Function Verification		Discipline Office		CONTRACTOR	FOR CDCF
Analytical Integration Models Verification		Discipline Office		CONTRACTOR	FOR CDCF
Pack and Ship to Launch Site (if required)	N/A			CONTRACTOR	FOR CDCF
Preintegration					
Unpack and Receiving Inspection	N/A		√		
Engineering Preps	N/A		√		
Post Delivery Verification	N/A		√		
Install in GSE	N/A		√		
Servicing	N/A		√		
Alignment	N/A		√		
Closeout and Turnover	N/A		√		
Experiment to Rack/PIA High Fidelity Test					
Experiment Integrated Requirements Definition	Flight Systems	Discipline		CONTRACTOR	FOR CDCF
Experiment Planning and Scheduling	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF
Experiment Functional Testing	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF
Interface Verification Testing	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF
Compatibility Testing	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF
End to End Test (if required)	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF

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PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment to Rack/PIA High Fidelity Test (Cont.)					
Closeout and Turnover	Flight Systems	+ Facility Mgt		CONTRACTOR	FOR CDCF
Rack/PIA to Space Station Integration					
Experiment Integrated Requirements Definition	Flight Systems				
Experiment Planning and Scheduling	Flight Systems				
Rack to SS Carrier Installation	Station		√		
Configure for Rack/PIA to SS I/F Verification	Station		√		
Rack/PIA to SS I/F Verification Testing	Station		√		
Closeout and Turnover	Station		√		
SS to Orbiter Preintegration (CITE)					
Experiment Integrated Requirements Definition		CDCF	√		
Experiment Planning and Scheduling		CDCF	√		
Configure for Launch	NSTS/Station		√		
SS to Orbiter I/F Verification Test (Simulation)	NSTS/Station		√		
Non-Hazardous Servicing and Stowage	NSTS/Station		√		
Closeout and Turnover	NSTS/Station		√		
SS to Orbiter Integration					
Experiment Integrated Requirements Definition		CDCF/GSFC	√		
Experiment Planning and Scheduling		CDCF/GSFC	√		
Canister Operations	NSTS/Station		√		
PCR Operations	NSTS/Station		√		
SS to Orbiter I/F Verification Test	NSTS/Station		√		
Pad Operations	NSTS/Station		√		
Hazardous Servicing	NSTS/Station		√		
Late Access	NSTS/Station		√		
Launch Countdown	NSTS/Station		√		
On-Orbit Integration Support					
Experiment Integrated Requirements Definition	Flight Systems	+Discipline/GSFC	√		
Experiment Planning and Scheduling	Flight Systems	+Discipline/GSFC	√		
Rack/PIA from Module/Orbiter Deintegration	NSTS/Station		√		
Rack/PIA to Freedom SS Integration	Station		√		
Rack/PIA to Freedom SS I/F Test	Station		√		
Experiment Testing	Station		√		
Rack/PIA from Freedom SS Deintegration	Station		√		
Rack/PIA to Module/Orbiter Integration	NSTS/Station		√		
Orbiter Deintegration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Early Access Retrieval	NSTS/Station				
SS from Orbiter Deintegration	NSTS/Station				
Deservice/Destowage	NSTS/Station				
Rack/PIA from SS Deintegration	NSTS/Station				

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PAYLOAD INTEGRATION CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Orbiter Deintegration (Cont.)					
Experiment from Rack/PIA Deintegration	Flight Systems				
Post Flight Inspection, Maintenance, Refurbishment	Flight Systems			CDCF	
Ship Experiment to Developer	Flight Systems			CDCF	

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE : SPACE PHYSICS (ES)
DATE : DECEMBER 6, 1988

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Payload Definition and Development					
Design/Fab/Test Hardware	Discipline Office			GSFC/MSFC	
GSE Definition, Design, Development	Discipline Office			GSFC/MSFC	
Analytical Integration of Experiment/Rack/PIA	Discipline Office			GSFC/MSFC	
Hardware Integration/Test Requirements Definition	Discipline Office			GSFC/MSFC	
Development of Training Hardware	Discipline Office			GSFC/MSFC	
Integration and Test Procedure Development	Discipline Office			GSFC/MSFC	
Certification Testing	Discipline Office			GSFC/MSFC	
Acceptance Testing	Discipline Office			GSFC/MSFC	
Acceptance Data Package Documentation	Discipline Office			GSFC/MSFC	
Pack and Ship	Discipline Office			GSFC/MSFC	
Preintegration					
Unpack and Receiving Inspection	Discipline Office			GSFC/MSFC	
Engineering Preps	Discipline Office			GSFC/MSFC	
Post Delivery Verification	Discipline Office			GSFC/MSFC	
Install in GSE	Discipline Office			GSFC/MSFC	
Servicing	Discipline Office			GSFC/MSFC	
Alignment	Discipline Office			GSFC/MSFC	
Closeout and Turnover	Discipline Office			GSFC/MSFC	
Experiment to Rack/PIA Integration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Rack/PIA and Integration H/W Receiving,Inspection,Checkout	Flight Systems		√		
Experiment H/W to Rack/PIA Integration	Flight Systems		√		
Experiment Testing	Discipline Office		√		
Stowage Fit and Function Verification	Flight Systems		√		
Analytical Integration Models Verification	Flight Systems		√		
Pack and Ship to Launch Site (if required)	N/A		√		
Preintegration					
Unpack and Receiving Inspection	N/A				
Engineering Preps	N/A				
Post Delivery Verification	N/A				
Install in GSE	N/A				
Servicing	N/A				
Alignment	N/A				
Closeout and Turnover	N/A				
Experiment to Rack/PIA High Fidelity Testing					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE : SPACE PHYSICS (ES)
DATE : DECEMBER 6, 1988

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Functional Testing	Flight Systems		√		
Interface Verification Testing	Flight Systems		√		
Compatibility Testing	Flight Systems		√		
End to End Test (if required)	Flight Systems		√		
Closeout and Turnover	Flight Systems		√		
Rack/PIA to Space Station Integration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Rack to SS Carrier Installation	Station		√		
Configure for Rack/PIA to SS I/F Verification	Station		√		
Rack/PIA to SS I/F Verification Testing	Station		√		
Closeout and Turnover	Station		√		
SS to Orbiter Preintegration (CITE)					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Configure for Launch	NSTS/Station		√		
SS to Orbiter I/F Verification Test (Simulation)	NSTS/Station		√		
Non-Hazardous Servicing and Stowage	NSTS/Station		√		
Closeout and Turnover	NSTS/Station		√		
SS to Orbiter Integration					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Canister Operations	NSTS/Station		√		
PCR Operations	NSTS/Station		√		
SS to Orbiter I/F Verification Test	NSTS/Station		√		
Pad Operations	NSTS/Station		√		
Hazardous Servicing	NSTS/Station		√		
Late Access	NSTS/Station		√		
Launch Countdown	NSTS/Station		√		
On-Orbit Integration Support					
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Rack/PIA from Module/Orbiter Deintegration	NSTS/Station		√		
Rack/PIA to Freedom SS Integration	Station		√		
Rack/PIA to Freedom SS I/F Test	Station		√		
Experiment Testing	Station		√		
Rack/PIA from Freedom SS Deintegration	Station		√		
Rack/PIA to Module/Orbiter Integration	NSTS/Station		√		
Orbiter Deintegration					

PAYLOAD INTEGRATION CENTERS

DISCIPLINE OFFICE : SPACE PHYSICS (ES)
DATE : DECEMBER 6, 1988

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (KSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Experiment Integrated Requirements Definition	Flight Systems		√		
Experiment Planning and Scheduling	Flight Systems		√		
Early Access Retrieval	N/A	N/A	N/A		
SS from Orbiter Deintegration	NSTS/Station		√		
Deservice/Destowage	NSTS/Station		√		
Rack/PIA from SS Deintegration	NSTS/Station		√		
Experiment from Rack/PIA Deintegration	Flight Systems		√		
Post Flight Inspection, Maintenance, Refurbishment	Flight Systems			GSFC/MSFC	
Ship Experiment to Developer	Flight Systems			GSFC/MSFC	

* KSC is the reference site for the integration center. If there is minimal impact to your payload when integration function/service specified is completed at KSC, so indicate by placing a checkmark (√) in this column.

Operations Matrices

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DISCIPLINE OFFICE : ASTROPHYSICS (EZ)
DATE : DECEMBER 6, 1988

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations					
Information Network/Data Distribution	Discipline			LANL/GSFC	
Discipline Resource Allocation	Discipline			LANL/GSFC	
Investigator Working Group (IWG)	Discipline			LANL/GSFC	
Science Readiness Review	Discipline			LANL/GSFC	
Science Operations Training					
Experiment Training Plan	Discipline			USER	
Experiment Operation Training	Discipline			USER	
Integrate Code E Mission Plans					
Consolidated Operations & Utilization Plan (COUP)	Flight Systems			USER	
Tactical Operations Plan (TOP)	Flight Systems			USER	
Increment Plan	Flight Systems			USER	
Payload Resource Allocation Plan	Flight Systems			USER	
Data Requirements & Distribution Plan	Flight Systems			USER	
Payload Science Management	Flight Systems			USER	
Payload Operations Readiness Review	Flight Systems			USER	
Payload Crew Training					
Payload Training Plan	Flight Systems				
Integrated Payload Training	Flight Systems				
Science Data Network Training	Flight Systems				
Operations Facilities Development					
Plans & Requirements	Various			LANL/GSFC	
Implementation Hardware & Software	Various			LANL/GSFC	
Test Verification & Training	Various			LANL/GSFC	
Integrate Code S Mission Plans					
Operation Management System	NSTS				
SSIS Utilization Plans	NSTS				
Mission Resource Allocation Plan	NSTS				
Mission Readiness Review	NSTS				
Mission Crew Training Plans					Minimal
Crew Training Plans	NSTS		√		
End-to-End Mission Training	NSTS		√		
Science Operations				LANL/GSFC	Pass through commands to
DOC/UOF Payload Operations	Discipline			LANL/GSFC	JSC or POCC locations.
Science Operation Status Reports	Discipline			LANL/GSFC	
Science Execution Replan	Discipline			LANL/GSFC	
Experiment Resource Status/Allocation	Discipline			LANL/GSFC	
Science Data Capture and Distribution	Discipline			LANL/GSFC	
Investigator Working Group (IWG)	Discipline			LANL/GSFC	

DISCIPLINE OFFICE : ASTROPHYSICS (EZ)
DATE : DECEMBER 6, 1988

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Science Operations (Cont.)				LANL/GSFC	Pass through commands to
Ground Facilities Operations & Maintenance	Discipline			LANL/GSFC	
Real Time Operations Integration				LANL/GSFC	Pass through/upload to JSC
Science Management Operation at POIC	Flight Systems			LANL/GSFC	
Science-to-Station Problem Resolution	Flight Systems			LANL/GSFC	
Science Mission Planning	Flight Systems			LANL/GSFC	
Ground Facilities Operations & Maintenance	Flight Systems			LANL/GSFC	
ROC Payload Operations	Flight Systems			LANL/GSFC	
Station Operations				LANL/GSFC	
POIC Management and Operations	NSTS			LANL/GSFC	
Mission Planning	NSTS			LANL/GSFC	
Operations Management System	NSTS			LANL/GSFC	
Mission Resource Status/Allocation	NSTS			LANL/GSFC	
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T			LANL/GSFC	
Station System Information to Users	NSTS			LANL/GSFC	
Data Capture	CODE T			LANL/GSFC	
Data Distribution	CODE EC			LANL/GSFC	
Data Archiving	CODE EC			LANL/GSFC	
Data Analysis	Discipline			LANL/GSFC	

* JSC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at JSC, so indicate by placing a checkmark (√) in this column.

LANL = Los Alamos National Labs

DISCIPLINE OFFICE : EE (Earth Science and Applications)
DATE : 12/8/88 (REVISED)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations	Discipline		√	GSFC	The integrated central command and control
Information Network/Data Distribution	Discipline		√	GSFC	center for EOS will be located at GSFC.
Discipline Resource Allocation	Discipline		√	GSFC	
Investigator Working Group (IWG)	Discipline		√	GSFC	
Science Readiness Review	Discipline				
Science Operations Training	Discipline		√	MSFC	Proposed EosDOC at MSFC for integrating
Experiment Training Plan	Discipline		√	MSFC	Eos operations into Manned Base (Attached
Experiment Operation Training	Discipline		√	MSFC	Payload) environment
Integrate Code E Mission Plans	Flight Systems		√		
Consolidated Operations & Utilization Plan (COUP)	Flight Systems		√		
Tactical Operations Plan (TOP)	Flight Systems		√		
Increment Plan	Flight Systems		√		
Payload Resource Allocation Plan	Flight Systems		√		
Data Requirements & Distribution Plan	Flight Systems		√		
Payload Science Management	Flight Systems		√		
Payload Operations Readiness Review	Flight Systems		√		
Payload Crew Training	Flight Systems		√	MSFC	If any crew time requirements
Payload Training Plan	Flight Systems		√	MSFC	
Integrated Payload Training	Flight Systems		√	MSFC	
Science Data Network Training	Flight Systems		√	MSFC	
Operations Facilities Development	Various		√	GSFC/MSFC	
Plans & Requirements	Various		√	GSFC/MSFC	
Implementation Hardware & Software	Various		√	GSFC/MSFC	
Test Verification & Training	Various		√	GSFC/MSFC	
Integrate Code S Mission Plans	NSTS	Flight Systems	√	MSFC	
Operation Management System	NSTS	Flight Systems	√	MSFC	
SSIS Utilization Plans	NSTS	Flight Systems	√	MSFC	
Mission Resource Allocation Plan	NSTS	Flight Systems	√	MSFC	
Mission Readiness Review	NSTS	Flight Systems	√	MSFC	
Mission Crew Training Plans	NSTS		√	MSFC	If any crew time requirements
Crew Training Plans	NSTS		√	MSFC	
End-to-End Mission Training	NSTS		√	MSFC	
Science Operations	Discipline		√		
DOC/UOF Payload Operations	Discipline			GSFC/MSFC	Some commands for EOS attached payloads to be
Science Operation Status Reports	Discipline			GSFC/MSFC	generated at GSFC, then forwarded via MSFC
Science Execution Replan	Discipline			GSFC/MSFC	transmission.
Experiment Resource Status/Allocation	Discipline		√	GSFC/MSFC	

DISCIPLINE OFFICE : EE (Earth Science and Applications)
DATE : 12/8/88 (REVISED)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Science Operations (Cont.)	Discipline		√		
Science Data Capture and Distribution	Discipline	OSO/GSFC	√	GSFC	
Investigator Working Group (IWG)	Discipline		√	GSFC/MSFC	
Ground Facilities Operations & Maintenance	Discipline		√	MSFC	
Real Time Operations Integration	Flight Systems		√		
Science Management Operation at POIC	Flight Systems		√	MSFC	
Science-to-Station Problem Resolution	Flight Systems		√	GSFC/MSFC	
Science Mission Planning	Flight Systems			GSFC/MSFC	
Ground Facilities Operations & Maintenance	Flight Systems		√	MSFC	
ROC Payload Operations	Flight Systems		√	GSFC/MSFC	
Station Operations	NSTS		√		
POIC Management and Operations	NSTS		√	MSFC	
Mission Planning	NSTS		√	MSFC	
Operations Management System	NSTS		√	MSFC	
Mission Resource Status/Allocation	NSTS		√	MSFC/GSFC	
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T		√	GSFC	
Station System Information to Users	NSTS	CODE S/CODE T	√	GSFC	
Data Capture	CODE T		√	GSFC	
Data Distribution	CODE EC	EE	√	GSFC	
Data Archiving	CODE EC	EE/EC		GSFC/SSSUAP	Active archive: EE, long-term archive: others
Data Analysis	Discipline			PIs	

* JSC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at JSC, so indicate by placing a checkmark (√) in this column.

PAYLOAD OPERATIONS CENTERS

DISCIPLINE OFFICE: Life Sciences Division - Ames
DATE:11/23/88

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations					
Information Network/Data Distribution	Discipline	Discipline		ARC	Intra-Discipline Responsibility
Discipline Resource Allocation	Discipline	Discipline		ARC	Intra-Discipline Responsibility
Discipline Investigator Working Group	Discipline	Discipline		ARC	Intra-Discipline Responsibility
Discipline Science Readiness Revies	Discipline	Discipline		ARC	Intra-Discipline Responsibility
Integrated Resource Alloocation		Flight Systems	√		
Integrated Investigator Working Group		Flight Systems	√		
Science Operations Training					
Discipline Experiment Training Plan (Crew)	Discipline	Discipline		ARC	Intra-Discipline Responsibility
Discipline Experiment Operation Training (Crew)	Discipline	Discipline		ARC	Req's Live at ARC and/or PI labs
Integrated Experiment Training Plan		Flight Systems			
Integrated Operation Training		Flight Systems			
Integrated Code E Mission Plans					
Consolidated Operations & Utilization Plan (COUP)	Flight Systems	Flight Systems	√		
Discipline Tacitcal Operations (TOP) Plan Input	N/A	Discipline		ARC	Integrated Plan for ARC Req'd as Input
Integrated Tactical Operations Plan (TOP)	Flight Systems	Flight Systems	√		
Discipline Increment Plan	N/A	Discipline		ARC	Integrated Plan for ARC Req'd as Input
Integrated Increment Plan	Flight Systems	Flight Systems	√		
Integrated Payload Resource Allocation Plan	Flight Systems	Flight Systems	√		
Integrated Data Requirements & Distribution Plan	Flight Systems	Flight Systems	√		
Integrated Payload Science Management	Flight Systems	Flight Systems	√		
Integrated Payload Operations Readiness Review	Flight Systems	Flight Systems	√		
Discipline Payload Resource Allocation Plan	N/A	Discipline		ARC	ARC must sub-allocate for Centrifuge Facility
Discipline Data Requirements & Distribution Plan	N/A	Discipline		ARC	ARC must sub-allocate for Centrifuge Facility
Discipline Payload Science Management	N/A	Discipline		ARC	ARC must sub-allocate for Centrifuge Facility
Discipline Payload Operations Readiness Review	N/A	Discipline		ARC	ARC must sub-allocate for Centrifuge Facility
Payload Crew Training					
Integrated Payload Training Plan	Flight Systems	Flight Systems	√		
Integrated Payload Training	Flight Systems	Flight Systems	√		
Science Data Network Training	Flight Systems	Flight Systems	√		
Discipline Systems Hardware Training	N/A	Discipline		ARC	Part of Integration & Test Process
Discipline Systems Hardware Assembly/Disassembly Training	N/A	Discipline		ARC	Part of Integration & Test Process
Operations Facilities Development	Various	Various		ARC	Ground Facility Req'd for Live Specimens
Plans & Requirments	Various	Various		ARC	Ground Facility Req'd for Live Specimens
Implementation Hardware & Software	Various	Various		ARC	Ground Facility Req'd for Live Specimens
Test Verification & Training	Various	Various		ARC	Ground Facility Req'd for Live Specimens
Integrate Code S Mission Plans	NSTS	NSTS	√		
Operation Management System	NSTS	NSTS	√		
SSIS Utilization Plans	NSTS	NSTS	√		
Mission Resource Allocation Plan	NSTS	NSTS	√		

PAYLOAD OPERATIONS CENTERS

DISCIPLINE OFFICE: Life Sciences Division - Ames
DATE: 11/23/88

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Mission Readiness Review	NSTS	NSTS	√		
Mission Crew Training Plans	NSTS	NSTS	√		
Crew Training Plans	NSTS	NSTS	√		
End-to-End Mission Training	NSTS	NSTS	√		
Science Operations					
DOC/UOF Payload Operations	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Science Operation Status Reports	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Science Execution Replan	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Experiment Replan	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Experiment Resource Status/Allocation	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Science Data Capture and Distribution	Discipline	Discipline		ARC	Discipline Responsibility
Discipline Investigator Working Group (IWG)	Discipline	Discipline		ARC	Discipline Responsibility
Experiment Problem Resolution	N/A	Discipline		ARC	Discipline Responsibility
Discipline System Hardware Problem Resolution	N/A	Discipline		ARC	Discipline Responsibility
Experiment Adjustments & Reconfiguration	N/A	Discipline		ARC	Discipline Responsibility
Integrated Science Operations Status Results	N/A	Flight Systems	√		
Integrated Experiment Resource Status/Allocation	N/A	Flight Systems	√		
Integrated Investigation Working Group	N/A	Flight Systems	√		
Ground Facilities Operatins & Maintenance	N/A	Various		ARC	For Facilities at ARC
Real Time Operations Integration	Flight Systems	Flight Systems	√		
Science Management Operation at POIC	Flight Systems	Flight Systems	√		
Science-to-Station Problem Resolution	Flight Systems	Flight Systems	√		
Science Mission Planning	Flight Systems	Flight Systems	√		
Ground Facilities Operations & Maintenance	Flight Systems	Flight Systems	√		
ROC Payload Operations	Flight Systems	Flight Systems	√		
Station Operations	NSTS	NSTS	√		
POIC Management and Operations	NSTS	NSTS	√		
Mission Planning	NSTS	NSTS	√		
Operations Management System	NSTS	NSTS	√		
Mission Resource Status/Allocation	NSTS	NSTS	√		
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T	CODE T		?	
Station System Information to Users	NSTS	?		?	
Data Capture	CODE T	CODE T		?	
Data Distribution	CODE EC	CODE EC		ARC	Data distributed through ARC
Data Archiving	CODE EC	CODE EC		?	
Data Analysis	Discipline	Discipline		ARC	

* MSFC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at MSFC, so indicate by placing a checkmark (√) in this column.

OSSA Space Station Payload Integration and Payload Operations Center Requirements Workshop
December 6-9, 1989

RATIONALE FOR REQUIREMENTS WORKSHOP MATRIX
PAYLOAD OPERATIONS CENTER
AMES RESEARCH CENTER

A discipline Operations Center located at Ames for the Biological Research Project (BRP) is stipulated in the matrix submitted for the Requirements Workshop. This capability, in conjunction with a Payload Integration Center to process flight hardware at the rack level as stipulated in the Requirement Workshop matrix for Payload Operations Centers, is important to the BRP success in implementing the non-human biological research program for Space Station Freedom. The rationale for this approach is introduced here to clarify the need for a Discipline Operations Center where investigators, their research equipment, and their ground experiments can support future and on-going flight operations. Biological scientists, bioscience engineers, and specimens will be sustained at Ames where operational planning, coordination, specialized training, and flight support can be best provided.

Ames Research Center has been assigned the lead role in NASA for non-human life sciences research. Within this charter, the center is responsible for implementation of the BRP, a project to conduct non-human biological investigations on-board Space Station Freedom. The BRP will develop and maintain a "permanent" biological research laboratory on-board Freedom; develop, test and integrate the required laboratory support equipment; develop experiment specific equipment; and manage science operations through the life of the Freedom project.

The implementation plan for BRP is based on Ames overall project experience, and specifically, life sciences experience on Spacelab, COSMOS, and STS secondary payloads.

Flight Operations for BRP will require a permanent organization for the life of the freedom project to manage the laboratory on-board Freedom and the associated ground facilities in support of a coordinated discipline research program. In general, the BRP program will support 10-20 flight experiments during each flight increment. Many of the experiments will extend over several flight increments. Most flight increments, however, will be used to conduct new and different sets of investigations for varied and diverse experimenters. Thus payload integration, training, flight planning, and Freedom operations support will be a continuing process. As discussed in the Payload Integrations Center rationale, the BRP plan is to perform the major portions of the prelaunch activities at Ames. Because monitoring and replanning for the current flight increment are so closely coupled to the continuing integration activities for future increments and ground control experiments, the BRP plan requires these activities be accomplished at Ames. This plan will provide the mechanism for a coordinated discipline input for current operations and future flight increment planning and resource allocation by the MSFC operations team at the POIC.

Most BRP flight investigations will require the conduct of near- synchronous ground control experiments. The use of live biological specimens for these experiments requires that the activities be carried out either at remote experimenter sites or at Ames. The BRP plan assumes most of these ground control experiments will be conducted at Ames, where they can share the Ames support resources with on-going biological research and with preflight tests for future increments.

In order to support the flight experiments, the BRP plan also includes direct forwarding of all BRP flight data to Ames for evaluation along with data gathered from the ground control experiments. As telescience interactions between Freedom and the ground are developed, Ames will also provide the focus for evaluation and feedback to the scientist astronauts.

The BRP plan provides the essential close coordination between flight operations and ground planning, control experiments, and evaluation by the use of a Discipline Operations Center. This approach allows the Project to provide an input to the integrated Freedom operations which represents a set of coordinated discipline plans and requirements. It also minimizes the requirements at the Freedom operations center for permanent facilities to support this project.

The matrix prepared by the BRP office for the workshop reflects this approach. Most of the items added to the draft matrix indicate the need for planning and management at the discipline level prior to integration of discipline requirements and activities into the overall Freedom flight operations activities. Below is an explanation of the matrix inputs by major section with the rationale to substantiate the BRP approach.

1. **Science Operations Requirements/Preparations** - page 1 of matrix

Ames will be the focal point for management and integration of non-human life science operations requirements through planning and coordination with a Non-Human Life Sciences Discipline Investigator Working Group. Included in this activity are resource allocations in terms of 1.8 Meter Centrifuge Facility resources, crew time lines, specimen sharing, etc. Ames will also provide appropriate instructions and coordination for those PI's who design and build their own experiment unique hardware to be used within the BRP payload. All resource allocations will be sub-allocated as required to support selected investigations. Readiness reviews will be held to ensure that all requirements and accommodations for the laboratory are supported. Resource allocations will be managed and tracked by the BRP Office throughout the planning, development and operational phases. Activities at the integrated level are supported by representatives of the BRP Office and Discipline Investigator Working Group.

2. **Science Operations Training** - page 1 of matrix

Detailed "hands-on" crew training is critical for life sciences experiments which include operations with complex equipment and manipulation of live specimens. Ames will be the focal point for specialized discipline experiment crew training. This will ensure the availability of resources and the coordination of schedules with the overall Freedom crew training activities, in addition to the development of detailed training plans. Subsequent to approval of the plan, implementation will be coordinated by the BRP Office, and training sessions conducted at Ames and/or investigator laboratories as appropriate.

Ames currently provides this capability for the Spacelab Program, and has the experience and expertise for this role for BRP.

3. **Integrated Code E Mission Plans** - page 1 of matrix

The BRP Office will develop multi-user discipline plans as inputs for the integrated Code E plans (TOPS's and COUP's).

Incremental planning will be implemented at the Ames DOC working with the SUM Office to ensure compatibility between the long-term scientific goals and Freedom flight increment planning. Centering these activities at the Ames DOC provides a coordinated discipline approach and allows synchronization of each flight increment plus effective planning, replanning and execution of multiple experiment investigations with differing durations within single or multiple flight increments.

An important reason for conducting these activities at the Ames Discipline Operations Center is the presence of the resident science staff who are familiar with the needs and requirements of the science community through continuing support of the discipline working groups. This, coupled with knowledge of the capabilities and accommodations available in the 1.8 Meter Centrifuge Facility and other ARC developed experiments and payload equipment, will provide the most responsive and cost effective means to support Integrated Mission Plans.

The development of Integrated Payload Resource Allocation plans requires supporting plans from the discipline centers. The BRP role is to coordinate the resource requirements for the multiple non-human life sciences investigators into a cohesive and resource-effective plan which will be provided to the Flight Systems Division (SUM) for inclusion in the integrated plan.

4. **Payload Crew Training** - page 2 of matrix

In concert with the science operations training outlined in Item 2 of this document, payload crew training, including hands-on training with ARC developed equipment, will be provided. Training sessions will be conducted at various phases of equipment development through final integration and test at the integrated system level and will use live specimens.

Our experience has shown that valuable feedback has been provided by the crew when crew training is conducted at the appropriate phases in the development process. In addition, the flight crew profits from familiarization with the configuration and operations of various components and subsystems gained by participation in the build-up and integration process. Crew familiarization manuals and procedures are continually updated through feedback from these sessions. The involvement of the crew in these early periods is vital due to the complexity of the activities to be conducted by the crew on-orbit (i.e., verification, assembly/ disassembly, long-term servicing, etc.)

Integrated payload training at MSFC will be supported by the BRP as required.

5. **Operations Facilities Development** - page 2 of matrix

The BRP Office plans to provide a Discipline Operations Center at Ames to manage and conduct flight operations. The existing Pioneer Operations Control Center will be available to support BRP operations. This center, which will be co-located with the planned Life Sciences Space Flight Facility (described in the Payload Integration material for the workshop), can be upgraded at a modest cost to meet Freedom program needs. It is presently configured for, and has operated for many years on an around-the-clock basis in support of the Pioneer program.

This operations center will be configured and equipped to receive data from MSFC, process the data as required by specific experiments, and pass it on to the experimenters as appropriate (electronically, data tapes, or hard copy). Existing connections with standard NASA networks provide the capability for transmission of data to and from Ames.

6. **Integrate Code S Mission Plans** - page 3 of matrix

The baseline approach shown in the matrix is consistent with the Ames scenario. These activities and their end products will be supported as required. Ames will have conducted a mission readiness review for each mission increment as a precursor to each Integrated Mission Readiness Review.

7. **Mission Crew Training Plans** - page 3 of matrix

End-to-end mission crew training conducted at MSFC will be supported by the BRP as required. Further training is assumed to be provided to selected crew members supporting specific payload integration and operations for each major discipline.

Training and support facilities are planned at Ames to provide discipline training of individual and/or groups of experiment investigations (including handling of live specimens) plus training with Ames developed systems (1.8 Meter Centrifuge Facility), and experiment unique hardware.

8. **Science Operations** - page 4 of matrix

The conduct of non-human life sciences experiments is an on-going and evolutionary process. Review of the data by the investigators along with results from ground control experiments may result in adjustments to current experiment operations. Such adjustments will be coordinated with other investigators sharing the experiment or specimens through the Discipline Investigator Working Group. Real-time science or experiment problem and problem resolution will be coordinated with the investigators to ensure the most effective resolution considering both science and animal welfare issues. The revised protocol will be cleared with the Animal Care and Use Committee (ACUC) Prior to implementation. In some cases ACUC approval will require ground testing with high-fidelity facility simulators.

To ensure that the feedback is coordinated on a discipline basis, that overall Freedom operations are conducted in an efficient manner, and that the individual investigators are not inundated with extraneous information, the DOC will act as the interface between the discipline science community and the POIC. Data from the laboratory on-board Freedom are transmitted to the Ames DOC via the POIC. The DOC will distribute it to individual investigators as required.

Interactions of specimens with the centrifuge facility and the microgravity environment cannot always be predicted, and continuing ground experiments will be required based upon knowledge and experience gained through on-orbit operations. In addition, evolution of the laboratory equipment will require hardware/specimen compatibility and verification testing as the scientific emphasis changes. This can only be done at the discipline center where the unique knowledge of specimen interactions is established.

Close interaction and coordination between the investigator and the Ames DOC is essential to ensure that all aspects of the science are addressed effectively and efficiently as possible. Location of the science community at the centralized POIC would not only be ineffective for ground control comparisons, but would require extensive travel and coordination of investigators to and from MSFC for the short periods.

Locating the operations are in close proximity to the ground support activities (hardware integration and test, operations simulations, etc.) provides valuable insight and crosstraining for both flight and ground operations personnel.'

The ground facility requirements, if all discipline flight operations are to be carried out at the POIC, are shown in Figure 8-1.

9. Real Time Operations Integration - page 4

The baseline approach shown in the matrix represents continuity within the Ames planning scenario. These activities will be supported by the Ames DOC as required.

10. Station Operations - page 5

Agree with baseline approach, i.e., locate this activity at MSFC.

The baseline approach shown in the matrix represents continuity with the BRP planning scenario. These activities will be supported by the Ames DOC as required.

11. Post-Mission Operations - page 5

The full intent or scope of the activities listed in the matrix are not clear. Further coordination is needed to prepare a matrix input.

DISCIPLINE OFFICE : JSC LIFE SCIENCES (EB)
DATE : 12/7/88; 1:00 a.m.

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations				JSC	Note 1
Information Network/Data Distribution	Discipline			JSC	Note 1
Discipline Resource Allocation	Discipline			JSC	Note 1
Discipline Investigator Working Group (IWG)	Discipline			JSC	Note 1
Discipline Science Readiness Review	Discipline			JSC	Note 1
Science Verification Tests	Discipline			JSC/PI	Note 1
Science Operations Training				JSC	Note 2
Experiment Training Plan	Discipline			JSC/PI	Note 2
Experiment Operation Training	Discipline			JSC/PI	Note 2
Integrate Code E Mission Plans					
Consolidated Operations & Utilization Plan (COUP)	Flight Systems		√		
Discipline Tactical Operations Plan (TOP) Input	Flight Systems	Discipline		JSC	Note 1
Discipline Increment Plan	Flight Systems	Discipline		JSC	
Integrated Tactical Operations Plan	Flight Systems		√		
Integrated Increment Plan	Flight Systems		√		
Integrated Payload Resource Allocation Plan	Flight Systems		√		
Integrated Data Requirements & Distribution Plan	Flight Systems		√		
Integrated Payload Science Management	Flight Systems		√		
Integrated Payload Operations Readiness Review	Flight Systems		√		
Discipline Payload Resource Allocation Plan	Flight Systems	Discipline		JSC	Note 1
Discipline Data Requirements & Distribution Plan	Flight Systems	Discipline		JSC	Note 1
Discipline Payload Science Management	Discipline	Discipline		JSC	Note 1
Discipline Payload Operations Readiness Review	Discipline	Discipline		JSC	Note 1
Baseline Data Coordination	Discipline	Discipline		JSC	Note 1
Payload Crew Training					
Payload Training Plan	Flight Systems	Joint		Flight Systems	
Integrated Payload Training	Flight Systems				
Science Data Network Training	Flight Systems	Various		POIC/JSC	
Discipline Crew Training	N/A	Discipline		JSC	Notes 1,2
Operations Facilities Development				Flight Systems	
Plans & Requirements	Various			Flight Systems	
Implementation Hardware & Software	Various			Flight Systems	
Test Verification & Training	Various			Flight Systems	
Integrate Code S Mission Plans					
Operation Management System	NSTS	Station			
SSIS Utilization Plans	NSTS	Station			
Mission Resource Allocation Plan	NSTS	Station			
Mission Readiness Review	NSTS	Station			
Mission Crew Training Plans					
Crew Training Plans	NSTS	Station			

DISCIPLINE OFFICE : JSC LIFE SCIENCES (EB)
DATE : 12/7/88; 1:00 a.m.

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Mission Crew Training Plans (Cont.)					
End-to-End Mission Training	NSTS	Station		SSMTF	
Science Operations		Discipline		JSC	Note 1
DOC/UOF Payload Operations	Discipline			JSC/UOF	Note 1
Science Operation Status Reports	Discipline			JSC	Note 1
Discipline Science Execution Replan	Discipline			JSC	Note 1
Experiment Resource Status/Allocation	Discipline			JSC	Note 1
Science Data Capture and Distribution	Discipline			JSC	Note 1
Discipline Investigator Working Group (IWG)	Discipline			JSC	Note 1
Ground Facilities Operations & Maintenance	Discipline	Various			
Integrated Science Operations Status		Flight Systems	√		
Integrated Resource Status/Allocation		Flight Systems	√		
Experiment Problem Resolution		Discipline		JSC/PI	Note 1
Real Time Operations Integration					
Science Management Operation at POIC	Flight Systems		√		
Science-to-Station Problem Resolution	Flight Systems		√		
Science Mission Planning	Flight Systems		√		
Ground Facilities Operations & Maintenance	Flight Systems	Various			
ROC Payload Operations	Flight Systems			JSC	For S&LSD Non-Life
Station Operations					
POIC Management and Operations	NSTS		√		
Mission Planning	NSTS		√		
Operations Management System	NSTS		√		
Mission Resource Status/Allocation	NSTS		√		
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T				
Station System Information to Users	NSTS				
Data Capture	CODE T			T/EC/JSC	
Data Distribution	CODE EC			EC/JSC	
Data Archiving	CODE EC	EC/Discipline			
Data Analysis	Discipline	Discipline			
Baseline Data Coordination	Discipline	Discipline		JSC	Note 1

1. The agency expertise for human life sciences is located at JSC. Discipline science operations should be planned and implemented from JSC to make efficient use of resources and experience.

2. Significant experiment development capabilities currently exist at JSC and these are highly integrated into the training for this discipline. These capabilities and experienced personnel should be used for discipline science training at JSC.

* MSFC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at MSFC, so indicate by placing a checkmark (√) in this column.

DISCIPLINE OFFICE: MSAD (CODE EN)
DATE: DECEMBER 7, 1988 (1:25 a.m.)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	MSAD REQUIRED LOCATION/ORGANIZATION LeRC	MSFC	JPL	JSC
Science Operations Requirements/Preparations							
Information Network/Data Distribution	Discipline Office	MSAD	√				
Discipline Resource Allocation	Discipline Office	MSAD	√				
Investigator Working Group	Discipline Office	MSAD	√				
Science Readiness Review	Discipline Office	MSAD	√				
Science Operations Training							
Experiment Training Plan	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Experiment Operations Training	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Integrate Code E Mission Plans							
Consolidated Operations & Util. Plan (COUP)	Flight Systems	Flight Systems	√				
Tactical Operations Plan (TOP)	Flight Systems	Flight Systems	√				
Increment Plan	Flight Systems	Flight Systems	√				
Payload Resource Allocation Plan	Flight Systems	Flight Systems	√				
Data Requirements & Distribution Plan	Flight Systems	Flight Systems	√				
Payload Science Management	Flight Systems	Flight Systems	√				
Payload Operations Readiness Review	Flight Systems	Flight Systems	√				
Payload Crew Training							
Payload Training Plan	Flight Systems	Flight Systems	√		Yes Page 2		
Integrated Payload Training	Flight Systems	Flight Systems	√		Yes Page 2		
Science Data Network Training	Flight Systems	Flight Systems	√		Yes Page 2		
Operations Facility Development							
Plans & Requirements	Various		√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Implementation Hardware & Software	Various		√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Test, Verification & Training	Various		√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Integrate Code S Mission Plans							
Operations Management System	Station	Station	√				
SSIS Utilization Plans	Station	Station	√				
Mission Resource Allocation Plan	Station	Station	√				
Mission Readiness Review	Station	Station	√				
Mission Crew Training Plans							
Crew Training Plans	Station	Station	√				
End-to-End Mission Training	Station	Station	√				
Science Operations							
DOC/UOF Payload Operations	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Science Operations Status Reports	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Science Execution Replan	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Experiment Resource Status/Allocation	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Science Data Capture and Distribution	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Investigator Working Group (IWG)	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Ground Facilities Operations & Maintenance	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD

R. Golden, J. Kearns

DISCIPLINE OFFICE: MSAD (CODE EN)
DATE: DECEMBER 7, 1988 (1:25 a.m.)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (MSFC*)	MSAD REQUIRED LOCATION/ORGANIZATION			
				LeRC	MSFC	JPL	JSC
Real Time Operations Integration							
Science Management Operations at POIC	Flight Systems	Flight Systems	√				TBD
Science-to-Station Problem Resolution	Flight Systems	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD
Science Mission Planning	Flight Systems	Flight Systems	√				TBD
Ground Facilities Operations & Planning	Flight Systems	Flight Systems	√				TBD
ROC Payload Operations	Flight Systems	Flight Systems	√				TBD
Station Operations							
POIC Management and Operations	Station	Station	√				
Mission Planning	Station	Station	√				
Operations Management System	Station	Station	√				
POST-MISSION OPERATIONS							
Station Systems Data to Users	Code T	Code T	√				
Station Systems Information to Users	Station	Station	√				
Data Capture	Code T	Code T	√				
Data Distribution	Code EC	Code EC	√				
Data Archiving	Code EC	Code EC	√				
Data Analysis	Discipline Office	MSAD	√	Yes Page 1	Yes Page 2	Yes Page 3	TBD

* MSFC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at MSFC, so indicate by placing a checkmark (√) in this column.

R. Golden, J. Kearns

MSAD JPL Requirements

General:

JPL is the leading NASA center in the area of containerless processing. They first designed and developed the Drop Dynamics Modules (DDM) which flew on Spacelab 2 and are presently designing its successor, the Drop Physics Module (DPM) for the USML series of flights. The DPM is the precursor for the Modular Containerless Processing Facility (MCPF) which is one of the six approved MSAD Space Station Freedom facilities. The DPM and the Acoustic Levitator Furnace (ALF) are expected to evolve into MCPF modules.

Operations Facility Development:

Beginning with the Code EC/EM operations baseline, JPL should modify and provide a plan for any operations facility located at JPL and should be responsible for the implementation and testing of such. This can be done with either MSAD or Flight Systems Division funding.

Science Operations:

The short range plan is for the PI's to perform their science operations at a MSAD operations center. In the long range planning, PI's prefer to have telescience capabilities at their home facilities and would be capable of supporting on-Station operations from there. The reporting and replanning could be done from many places, but the PI must have active input into the process. The experiment resources will be monitored by the PI from his/her facility and will be allocated from an Operations Center, such as JPL (this assumes the availability of telescience).

Real Time Operations Integration:

Each development center must have the science-to-station problem resolution capability in order to routinely trouble shoot not only experiment module but also to monitor and maintain their facility effectively and efficiently. The facility engineers most knowledgeable of the on-board facility will most likely be located at the development center working on the update of their facility in preparation of upcoming flights.

Data Analysis:

In order to perform science efficiently on Station, each development center must have data analysis capability.

MSAD JSC Requirements

General:

The MSAD/JSC microgravity science effort is in the area of biotechnology. JSC is presently designing the Bioreactor for flight on the Shuttle. This experience will evolve into the design and then development of the Biotechnology Facility to be flown on the Space Station Freedom of which the Bioreactor will be a precursor.

TBD

MSAD LeRC Requirements

General:

LeRC is the NASA science base for microgravity combustion science and microgravity fluid physics and dynamics experiments. They presently have the responsibility for the definition of the MSAD Microgravity Combustion Facility (MCF) and the MSAD Fluid Physics/Dynamics Facility (FP/DF) with plans to extend this responsibility into the development of these Space Station Freedom facilities. Included with this effort will be the design and development of the individual MCF and FP/DF experiment modules.

Science Operations Training:

The development center has all the materials necessary to train the crew in the science aspects of the investigation for which they have been selected. These would include instruction materials and breadboard/development hardware that has supported the evolution of the science to be studied. This approach has worked very well for Spacelab and Skylab investigators.

Operations Facility Development:

Beginning with the Code EC/EM operations baseline, LeRC should modify and provide a plan for any operations facility located at LeRC and should be responsible for the implementation and testing of such. This can be done with either MSAD or Flight Systems Division funding.

Science Operations:

The short range plan is for the PI's to perform their science operations at a MSAD operations center. In the long range planning, PI's prefer to have telescience capabilities at their home facilities and would be capable of supporting on-Station operations from there. The reporting and replanning could be done from many places, but the PI must have active input into the process. The experiment resources will be monitored by the PI from his/her facility and will be allocated from an Operations Center, such as LeRC (this assumes the availability of telescience).

Real Time Operations Integration:

Each development center must have the science-to-station problem resolution capability in order to routinely trouble shoot not only experiment module but also to monitor and maintain their facility effectively and efficiently. The facility engineers most knowledgeable of the on-board facility will most likely be located at the development center working on the update of their facility in preparation of upcoming flights.

Data Analysis:

In order to perform science efficiently on Station, each development center must have data analysis capability.

MSAD MSFC Requirements

General:

MSFC expertise lies in the microgravity crystal growth and microgravity furnace areas. They are currently developing hardware for use on the Shuttle and the USML series which are expected precursors to Space Station Freedom experiment modules. Due to this expertise, they are presently designing the Advanced Protein Crystal Growth Facility (APCGF) and the Space Station Furnace Facility (SSFF).

Science Operations Training:

The development center has all the materials necessary to train the crew in the science aspects of the investigation for which they have been selected. These would include instruction materials and breadboard/development hardware that has supported the evolution of the science to be studied. This approach has worked very well for Spacelab and Skylab investigators.

Payload Crew Training:

The Principal Investigators can support these tasks from their facilities. The integrated payloads crew tasks would be developed by a "science operations center," such as MSFC.

Operations Facility Development:

Beginning with the Code EC/EM operations baseline, MSFC should modify and provide a plan for any operations facility located at MSFC and should be responsible for the implementation and testing of such. This can be done with either MSAD or Flight Systems Division funding.

Science Operations:

The short range plan is for the PI's to perform their science operations at a MSAD operations center. In the long range planning, PI's prefer to have telescience capabilities at their home facilities and would be capable of supporting on-Station operations from there. The reporting and replanning could be done from many places, but the PI must have active input into the process. The experiment resources will be monitored by the PI from his/her facility and will be allocated from an Operations Center, such as MSFC (this assumes the availability of telescience).

Real Time Operations Integration:

Each development center must have the science-to-station problem resolution capability in order to routinely trouble shoot not only experiment module but also to monitor and maintain their facility effectively and efficiently. The facility engineers most knowledgeable of the on-board facility will most likely be located at the development center working on the update of their facility in preparation of upcoming flights.

Data Analysis:

In order to perform science efficiently on Station, each development center must have data analysis capability.

DISCIPLINE OFFICE : SOLAR SYSTEM EXPLORATION (EL)
DATE : 12/6/88 (10:20 P.M.)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations	Discipline		√		
Information Network/Data Distribution	Discipline		√		
Discipline Resource Allocation	Discipline		√		
Investigator Working Group (IWG)	Discipline		√		
Science Readiness Review	Discipline		√		
Science Operations Training	Discipline				
Experiment Training Plan	Discipline		√		
Experiment Operation Training	Discipline		√		
Integrate Code E Mission Plans	Flight Systems				
Consolidated Operations & Utilization Plan (COUP)	Flight Systems				
Tactical Operations Plan (TOP)	Flight Systems				
Increment Plan	Flight Systems				
Payload Resource Allocation Plan	Flight Systems				
Data Requirements & Distribution Plan	Flight Systems				
Payload Science Management	Flight Systems		√		
Payload Operations Readiness Review	Flight Systems		√		
Payload Crew Training	Flight Systems				
Payload Training Plan	Flight Systems		√		
Integrated Payload Training	Flight Systems		√		
Science Data Network Training	Flight Systems		√		
Operations Facilities Development	Various				
Plans & Requirements	Various		√		
Implementation Hardware & Software	Various		√		
Test Verification & Training	Various		√		
Integrate Code S Mission Plans	NSTS			?	
Operation Management System	NSTS			?	
SSIS Utilization Plans	NSTS			?	
Mission Resource Allocation Plan	NSTS			?	
Mission Readiness Review	NSTS			?	
Mission Crew Training Plans	NSTS				
Crew Training Plans	NSTS		√		
End-to-End Mission Training	NSTS		√		
Science Operations	Discipline		√		
DOC/UOF Payload Operations	Discipline		√		
Science Operation Status Reports	Discipline		√		
Science Execution Replan	Discipline		√		
Experiment Resource Status/Allocation	Discipline		√		
Science Data Capture and Distribution	Discipline		√		
Investigator Working Group (IWG)	Discipline			?	

DISCIPLINE OFFICE : SOLAR SYSTEM EXPLORATION (EL)
DATE : 12/6/88 (10:20 P.M.)

PAYLOAD OPERATIONS CENTERS

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Science Operations (Cont.)	Discipline		√		
Ground Facilities Operations & Maintenance	Discipline		√		
Real Time Operations Integration	Flight Systems				
Science Management Operation at POIC	Flight Systems				
Science-to-Station Problem Resolution	Flight Systems				
Science Mission Planning	Flight Systems	Discipline ?		Various	
Ground Facilities Operations & Maintenance	Flight Systems	Discipline ?		Various	
ROC Payload Operations	Flight Systems	JSC	√		
Station Operations	NSTS				
POIC Management and Operations	NSTS			MSFC	
Mission Planning	NSTS			MSFC	
Operations Management System	NSTS			MSFC	
Mission Resource Status/Allocation	NSTS			MSFC	
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T			?	
Station System Information to Users	NSTS			?	
Data Capture	CODE T			?	
Data Distribution	CODE EC			?	
Data Archiving	CODE EC		√	JPL/Univ.	Science Data also Archived by Discipline
Data Analysis	Discipline		√	JPL/Univ.	Data Archiving and Analysis may be Done

* JSC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at JSC, so indicate by placing a checkmark (√) in this column.

C-2

PAYLOAD OPERATIONS CENTERS

DISCIPLINE OFFICE: ES
DATE: DECEMBER 6, 1988

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
PRE-MISSION OPERATIONS					
Science Operations Requirements/Preparations					
Information Network/Data Distribution	Discipline			GSFC/MSFC	GSFC will be location
Discipline Resource Allocation	Discipline			GSFC/MSFC	of a major Discipline
Investigator Working Group (IWG)	Discipline			GSFC/MSFC	Operations Center
Science Readiness Review	Discipline			GSFC/MSFC	
Science Operations Training					
Experiment Training Plan	Discipline			MSFC	
Experiment Operation Training	Discipline			MSFC	
Integrate Code E Mission Plans					
Consolidated Operations & Utilization Plan (COUP)	Flight Systems			GSFC/MSFC	See above
Tactical Operations Plan (TOP)	Flight Systems			GSFC/MSFC	
Increment Plan	Flight Systems			GSFC/MSFC	
Payload Resource Allocation Plan	Flight Systems			GSFC/MSFC	
Data Requirements & Distribution Plan	Flight Systems			GSFC/MSFC	
Payload Science Management	Flight Systems			GSFC/MSFC	
Payload Operations Readiness Review	Flight Systems			GSFC/MSFC	
Payload Crew Training					
Payload Training Plan	Flight Systems			MSFC	
Integrated Payload Training	Flight Systems			MSFC	
Science Data Network Training	N/A	N/A	N/A	N/A	
Operations Facilities Development					
Plans & Requirements	Various	Discipline		GSFC/MSFC	
Implementation Hardware & Software	Various	Discipline		GSFC/MSFC	
Test Verification & Training	Various	Discipline		GSFC/MSFC	
Integrate Code S Mission Plans					
Operation Management System	NSTS		√		
SSIS Utilization Plans	NSTS		√		
Mission Resource Allocation Plan	NSTS		√		
Mission Readiness Review	NSTS		√		
Mission Crew Training Plans					
Crew Training Plans	NSTS		√		
End-to-End Mission Training	NSTS		√		
Science Operations					
DOC/UOF Payload Operations	Discipline			GSFC/MSFC	GSFC will be location
Science Operation Status Reports	Discipline			GSFC/MSFC	of Discipline Operations Center

PAYLOAD OPERATIONS CENTERS

DISCIPLINE OFFICE : ES
DATE : DECEMBER 6, 1988

FUNCTIONS/SERVICES	RESPONSIBLE ORGANIZATION (SPACELAB)	PROPOSED RESPONSIBLE ORGANIZATION	STRAWMAN LOCATION (JSC*)	ALTERNATE DISTRIBUTION	WHY? (ATTACH PAGES AND REFERENCE HERE)
Science Execution Replan	Discipline			GSFC/MSFC	
Experiment Resource Status/Allocation	Discipline			GSFC/MSFC	
Science Data Capture and Distribution	Discipline			GSFC/MSFC	
Investigator Working Group (IWG)	Discipline			GSFC/MSFC	
Ground Facilities Operations & Maintenance	Discipline			GSFC/MSFC	
Real Time Operations Integration					
Science Management Operation at POIC	Flight Systems			MSFC	POIC is located at MSFC
Science-to-Station Problem Resolution	Flight Systems			MSFC	
Science Mission Planning	Flight Systems	Discipline		GSFC	See above
Ground Facilities Operations & Maintenance	Flight Systems	Discipline		GSFC	
ROC Payload Operations	Flight Systems	Discipline		GSFC	
Station Operations					
POIC Management and Operations	NSTS			MSFC	
Mission Planning	NSTS			MSFC	
Operations Management System	NSTS			MSFC	
Mission Resource Status/Allocation	NSTS			MSFC	
POST-MISSION OPERATIONS					
Station Systems Data to Users	CODE T			MSFC	
Station System Information to Users	NSTS			MSFC	
Data Capture	CODE T			GSFC	
Data Distribution	CODE EC	Discipline		GSFC/MSFC	
Data Archiving	CODE EC			GSFC	
Data Analysis	Discipline			GSFC/MSFC	

* JSC is the reference site for the operations center. If there is minimal impact to your payload when operations function/service specified is completed at JSC, so indicate by placing a checkmark (√) in this column.

Appendix D: MUS Payload Model

This appendix contains viewgraphs used during the workshop to describe the assumptions of the Multilateral Utilization Study (MUS). The payload information in the MUS study was used as baseline information for the workshop.

SPACE STATION
PAYLOAD INTEGRATION AND OPERATIONS WORKSHOP, OSSA "PAYLOAD MODEL" WORKING ASSUMPTIONS

- MUS "ALLOCATED" MISSION SET USED FOR SIZING PURPOSES, EXCEPT
  - OSSA HAS USE OF 4 APAE SETS
  - ACCOMMODATIONS ASSUMED FOR DISTRIBUTED SENSORS (I.E., PIMS) AND SMALL & RAPID RESPONSE PAYLOADS
- ALL OSSA ALLOCATED PAYLOADS ON ORBIT BY END OF ASSEMBLY SEQUENCE
- PHYSICAL INTEGRATION AT KSC FOR U.S. PAYLOADS FLYING IN/ON NON-U.S. ELEMENTS

ALLOCATION ASSUMPTIONS FOR DEVELOPMENT OF MUS TEST MISSION SETS

		NASA	ESA	NASDA	NRCC	TOTAL
ACCOMMODATIONS	NASA LABORATORY (d-racks)	28.5			Transferred to ESA Lab	28.5
	NASA NODE (d-racks)	5.5				5.5
	ESA LABORATORY (d-racks)	11.0	13.0		2.0	26.0
	NASDA LABORATORY (d-racks)	5.0		5.0	Transferred to ESA Lab	10.0
	NASDA EXP. LOG. MODULE (d-racks)	1.4		1.5	0.1	3.0
	TOTAL d-racks	51.4	13.0	6.5	2.1	73.0
	NASA TRUSS (no. of APAE sets)	6.0** 3 purchased	1 purchased		Transferred to NASDA EF	6.0 4 purchased
	NASDA EXP. FACILITY (attach points)	4.0		5.0	1.0	10.0

**Workshop Assumption: No APAE allocation assumed for ESA payloads (unlike MUS)

ALLOCATION ASSUMPTIONS: NASA SHARE (MUS ALLOCATED TEST SET)

		OSSA	OAST	OCP	SSFP	TOTAL NASA	TOTAL AVAIL
ACCOMMODATIONS	NASA LABORATORY (d-racks)	13.5	6.0	5.0	4.0	28.5	28.5
	NASA NODE (d-racks)	4.5			1.0	5.5	5.5
	ESA LABORATORY (d-racks)	3.5	2.0	2.5	3.0	11.0	26.0
	NASDA LABORATORY (d-racks)	2.5	1.0	1.5		5.0	10.0
	NASDA EXP. LOG. MODULE (d-racks)	1.0	0.2	0.2		1.4	3.0
	TOTAL d-racks	25.0	9.2	9.2	8.0*	51.4	73.0
	NASA TRUSS (no. of APAE sets)	4	1	1		6	6
	NASDA EXP. FACILITY (attach points)	2	1	1		4	10

*Common lab support equipment and 2 racks for reserves.
- PROCESS MATERIALS MANAGEMENT SYSTEM
- POTABLE WATER
- GLOVE BOXES
- CREW (APAE) SUPPORT STATION

ALLOCATION ASSUMPTIONS: OSSA SHARE (MUS ALLOCATED TEST SET)

ACCOMMODATIONS	LIFE SCIENCE	MICRO-GRAVITY	LAB SUPT EQUIP	TOTAL OSSA
NASA LABORATORY (d-racks)	5.0	7.0	1.5	13.5
NASA NODE (d-racks)	3.5		1.0	4.5
ESA LABORATORY (d-racks)		1.0	2.5	3.5
NASDA LABORATORY (d-racks)	0.5	1.0	1.0	2.5
NASDA EXP. LOG. MODULE (d-racks)			1.0	1.0
TOTAL d-racks	9.0	9.0	7.0	25.0

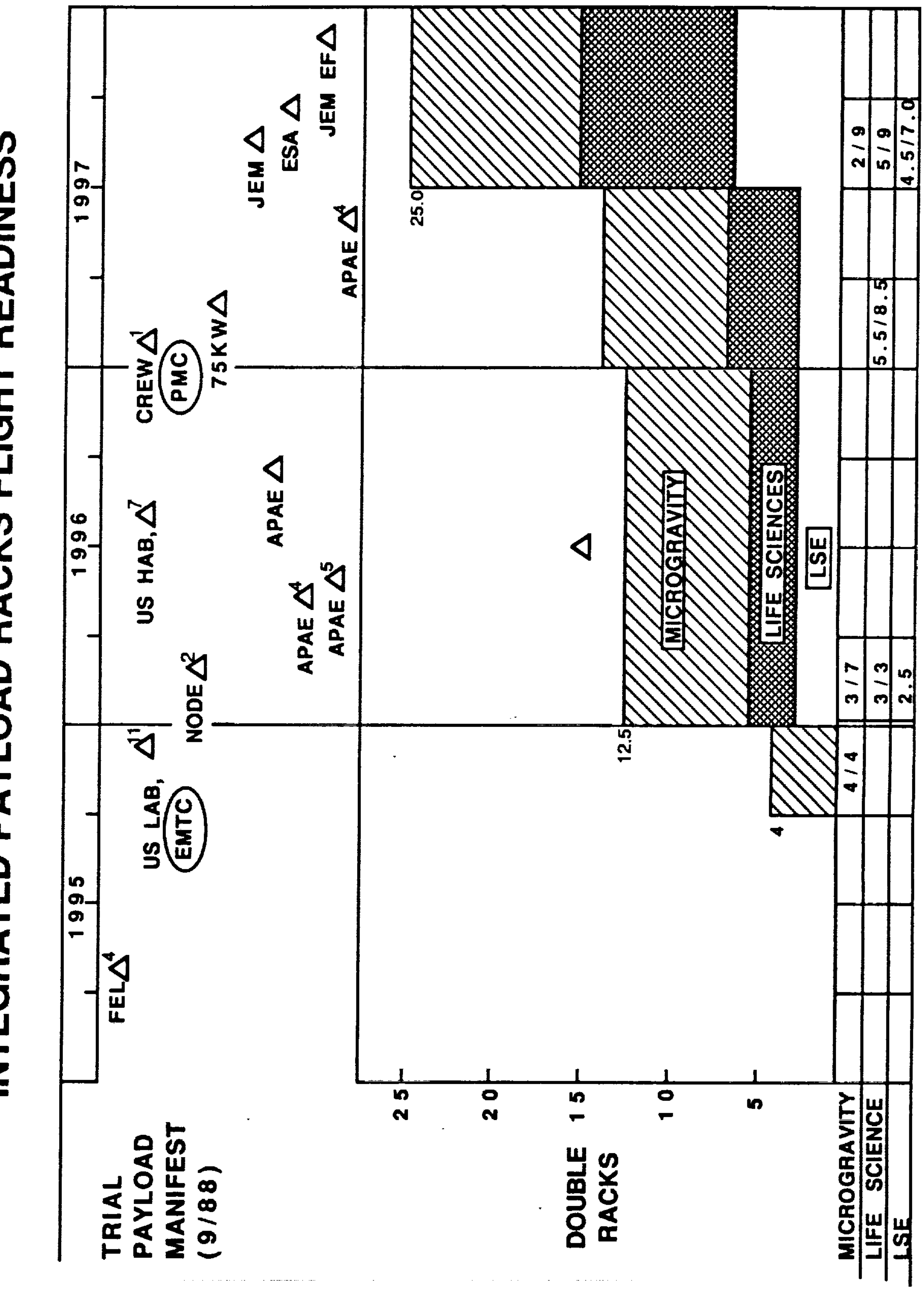
LIFE SCIENCES

- CENTRIFUGE & ANIMAL HOLDING FACILITY
- ANALYTICAL EQUIPMENT/BIOINSTRUMENTS
- LIFE SCIENCE COMPUTER/BIOSAMPLE MANAGEMENT
- BIOREGENERATIVE LIFE SUPPORT FACILITY
- EXOBIOLOGY FACILITY
- LIFE SCIENCE LSE

MICROGRAVITY

- ADVANCED PROTEIN CRYSTAL FACILITY
- BIOTECHNOLOGY FACILITY
- FLUID PHYSICS/DYNAMICS FACILITY
- MODULAR COMBUSTION FACILITY
- MODULAR CONTAINERLESS PROCESSING FACILITY
- SPACE STATION FURNACE FACILITY

INTEGRATED PAYLOAD RACKS FLIGHT READINESS



OSSA ATTACHED PAYLOADS - WORKING ASSUMPTIONS

PAYLOAD	LAUNCH READINESS
COSMIC DUST COLLECTOR (APAE)	1 H 96
TRIS/TRMM/ERBE (APAE)	2 H 96
ASTROMAG (APAE)	1 H 97
ASTROMETRIC TELESCOPE	2 H 97
PIMS - 5	
SARR - 10	

APPENDIX E: List of Attendees

OSSA PAYLOAD INTEGRATION/OPERATIONS WORKSHOP

ATTENDANCE LIST

NAME	ORGANIZATION
M. AIZENMAN	NSF
F. AMLEE	GEGS
A. ANDERSON	JSC
G. ANIKIS	GSFC
T. ARVIDSON	GE
D. ATCHISON	LESC
F. BEDNARZ	GEGS
P. BLIZZARD	BAH
L. BLOMSTROM	GE
O. BRANDT	LESC
J. BREDEKAMP	NASA HQ/EC
R. BUCHAN	LARC
M. BUDERER	JSC
J. BULLMAN	MSFC
M. BURROUGHS	PSC
J. CARPENTER	LESC
W. CAUSEY	MSFC
C. CHAPPELL	MSFC
R. CLARK	NASA/SSU
N. CONNER	GEGS
P. CRESSY	NASA HQ/EM
R. DAVIS	UNIV. OF COLORADO
J. DEARING	LARC
D. DEGRACE	LARC
B. DICKEY	GEGS
J. DICKINSON	GE
R. DORIAN	NASA/SSU
C. DUNKER	GSFC
H. DUNTON	GRUMMAN
J. DYER	ARC
W. EATON	JSC
E. ELLER	SAIC
J. ESTES	SSSAAS

H. FIZHUGH	JPL
E. FLOWERS	NASA/SSU
J. FOUNTAIN	NASA HQ/C
H. FRIECEVICH	JSC
J. GERVIN	GSFC
J. GITELMAN	NASA
J. GIVENS	ARC
H. GOLDEN	MSFC
R. GOLDEN	BIONETICS
C. GRINER	NASA HQ/SU
D. GROUNDS	JSC
R. GRUMM	JPL
C. HAGOOD	MDAC
R. HEUSER	KSC
T. HORN	GE
P. HOUSTON	KSC
H. HUBER	JSC
L. HUNT	KRUG
G. HYDE	HUGHES/SBRC
S. IZUMISAWA	MHI
G. JENKINS	TDE
A. JOHNSON	NASA/SSU
V. JONES	NASA HQ/ES
R. JONSSON	ESA
C. JONES	MSFC
L. KALLA	JSC
J. KEARNS	NASA HQ/EN
M. KIEFFER	PSC
J. KILPATRICK	MSFC
D. KOZARSKY	LESC
F. KURTZ	MSFC
J. LAKE	GEGS
P. LANTHER	LESC
P. LESTER	GEGS
P. LEVITT	PSC
G. LIDE	TRW
G. LUTZ	GEGS
E. LYNCH	NIH
D. MATSON	MDAC
W. MCALLUM	JSC
S. MCMAHON	JPL

W. MILLER	GSFC
W. MISKELL	BDM
E. MONTOYA	NASA HQ/EM
D. MORRISON	NASA HQ/EL
G. MUSGRAVE	BDM
T. NAGY	NASA HQ/EZ
K. NISHIOKA	ARC
H. OLIVER	MSFC
J. ORAM	LERC
W. OYLER	KSC
W. PAROBY	PSC
R. PARKER	LERC
T. PARIDIS	GSFC
W. PARSONS	BDM
M. PASCIUTO	NASA HQ/SI
R. PATTERSON	JSC
M. PAYONT	GE
C. PEARSON	GEGS
D. PERRY	GE
R. PHILLIPS	USDA
E. PICKETT	NASA HQ/SO
B. PIERMAN	GSFC
S. PORTAS	NASA HQ/SU
H. POWELL	MDAC
J. POWELL	MDAC
R. PRICE	GSFC
R. PUGSLEY	GEGS
J. RAFERT	FIT
T. RECIO	MSFC
E. REEVES	NASA HQ/EM
C. ROBINSON	JSC
T. ROZAS	GE
E. SCHMERLING	NASA HQ/EC
W. SCOTT	MDAC
M. SEDLAZEK	GSFC
E. SHERRILL	KSC
M. SHOMBERG	GE
M. SISTILLI	NASA HQ/EM
A. SLEDD	MSFC
R. SMITH	KRUG
E. SPEAKER	FIT

P. STABEKIS	LESC
J. STECHER	GSFC
D. STOUGHTON	NASA HQ/EM
R. TILLEY	KSC
J. TIMMONS	NASA HQ/EEU
D. VAN PELT	BDM
G. VITEMB	GEGS
D. WEBB	KSC
W. WEBB	GSFC
A. WEBB	JPL
J. WEBER	MDAC
E. WELLS	NASA/SSUU
R. WHITE	JPL
T. WHITE	JSC
G. WICKS	MSFC
R. WILLIAMS	NASA/SSI
R. WYNNE	GEGS
R. YACKOVETSKY	NASA/SSU
P. ZION	NASA HQ/EEU